THE
VETERINARY JOURNAL

Editor:
FREDERICK HOBDAY, C.M.G., F.R.C.V.S., F.R.S.E.,
HONORARY VETERINARY SURGEON TO HIS MAJESTY THE KING,
OFFICIER DU MÉRITE AGRICOLE (FRANCE),
CAVALIERE DEI SS. MAURIZIO E LAZZARO (ITALY),
HONORARY MEMBER OF THE AMERICAN VETERINARY ASSOCIATION,
PRINCIPAL OF THE ROYAL VETERINARY COLLEGE, LONDON.

Sub-Editor:
GLADSTONE MAYALL, M.R.C.V.S.

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THE SHORTAGE OF QUALIFIED VETERINARY ASSISTANTS.

It is somewhat phenomenal in these days to be able to name a profession which is not only not overcrowded but has actually a shortage of supply behind its ranks. That such, however, is the case with the veterinary profession at the present time, and indeed has been for some time, can readily be confirmed by a glance at the advertisement columns of our weekly contemporary, *The Veterinary Record*. This periodical is the official organ of the National Veterinary Medical Association of Great Britain and Ireland, and the chief means of *liaison* between the general practitioner, the laboratory worker, the newly qualified graduate, and also the senior student.

For some time now the principal advertisement columns of this paper have contained very many more demands for assistants than any of the Colleges have been able to supply, and only last week the advertisements asking for assistants or *locum tenens* were more than three times that of qualified graduates seeking employment.

In this respect we are not alone in the world, as America is in a similar position, for there are only a comparatively small number qualifying each year; so that, as with us, the quack flourishes. The deaths in Great Britain and Ireland in 1930–31 were eighty-six in number, and the entries only sixty-four. To what can we attribute this shortage of new aspirants? It began some years ago when the motor began to displace the horse; and parents, in consequence, fearing that the horse would disappear altogether (and looking upon the veterinary surgeons as doctors of horses and horse ailments only) advised their sons not to enter the veterinary profession. They omitted to observe the outlet on the Public Health side for the detection and prevention of the diseases of milk and meat, and the diseases communicable to man, and inter-communicable between the animals themselves. They were unaware of the Army Veterinary Service, the State and Municipal aspect, and the openings in the Colonies. The young graduate of to-day, unless he has been keen on the practical work of his profession, does not usually try to obtain an assistantship, and to enter private practice, but prefers an appointment where he has a fixed salary with steady (although often, at present, very inadequate) promotion, and the prospects of a pension at the retiring age, with more or less fixed hours of working and holidays, and his Sundays free from the professional telephone or the surgery bell. If he is of a studious mind and proper

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age, he has little difficulty in obtaining such a post, and when once embarked on this career he finds it difficult to return to private practice, should he care to do so.

The consequence is that the demand from practitioners for assistants or locums is considerably greater than the supply, and it certainly seems as if this state of affairs will continue for several years; and for those who usually take a holiday during the vacation time, and require a *locum tenens*, it will be well if they make an allowance for this and arrange early for the working of their practices during that period.

The following extract from the Annual Report of the Royal College of Veterinary Surgeons is of interest:

EXAMINATIONS.

Membership Diploma.—The following tables show the number of students presented for examination during the years 1930 and 1931:

	1930				1931			
	Examined.	Pass.	Fail.	Pass %.	Examined.	Pass.	Fail.	Pass %.
A ...	144	107	37	74.30	205	122	83	59.51
B ...	155	106	49	69.39	157	104	53	66.24
C ...	141	57	84	40.42	196	83	113	42.35
D ...	87	64	23	73.56	72	55	17	76.39
	527	334	193	63.37	630	364	266	57.77

It will be observed that a total of only 55, from all the Colleges, secured the M.R.C.V.S. Diploma—an utterly inadequate number to supply the needs of the profession—especially when one also takes into consideration the death ratio; and the addition of a year of study to the College course will, temporarily at any rate, be sure to be felt too. One can truly say that the prospects of the aspirant to the veterinary profession compare favourably with those of the other learned professions.

A FURTHER APPEAL FOR THE LONDON VETERINARY COLLEGE.

MANY readers of THE VETERINARY JOURNAL will have seen mentioned in the daily and weekly papers during the last few weeks the serious position with which the Royal Veterinary College, London, is faced, and of the great efforts which are being made to put its work on a safe footing. For many years the College has been carrying on under conditions which are very nearly unbearable; and it is now announced that the College buildings—parts of which are propped up, and have now been condemned by the L.C.C.—are likely at any time to collapse.

The need for help is desperate and urgent. On the Government Departmental Committee's recommendation the Treasury has promised a grant of £150,000, provided that the College can itself raise £100,000. Of this vast sum, £75,000 has already been secured, but it is necessary to find immediately the outstanding £25,000. It would be difficult to imagine any cause which can be pleaded with greater sincerity and justice. For over 140 years the College has been a source and centre of veterinary knowledge throughout Great Britain. It has given training to veterinary surgeons who have gone out all over the country, and indeed all over the world, to devote their lives to the care of animals.

In order to give the widest possible scope to the appeal, a great competition has been launched by Odham's Press with a first prize of £15,000. We hope that this venture will receive the support it deserves, and that the promoters' efforts will meet with success.

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General Articles

A COMPARISON OF THE BLOOD AND MILK AGGLUTINATION TESTS IN THE DETECTION OF BOVINE CONTAGIOUS ABORTION.

By R. F. MONTGOMERIE, B.Sc., Ph.D., F.R.C.V.S., and W. T. ROWLANDS, M.R.C.V.S., D.V.S.M.,

School of Agriculture, University College of North Wales, Bangor.

WHILE the presence of *B. abortus* antibodies in the milk of infected cows has been the subject of much work in recent years, attention has chiefly been directed towards their significance as an indication of udder infection. Only occasionally has the comparative value of the examination of blood and of milk as a means of diagnosis been investigated. The presence of *B. abortus* agglutinins in the milk of infected cows was first observed by McFadyean and Stockman[7] (1909), but they regarded milk as unsuitable test material on account of its opacity. Seddon[14] (1915), using whey obtained by coagulating milk with lactic acid, concluded that the testing of whey was a diagnostic procedure worthy of further investigation. Reinhardt and Ganss[11] (1915), employing whey from milk to which rennet had been added, found that the agglutinin content of whey was in close parallel to that of serum, but at a lower level. They concluded that a whey titre of 1/20 must be regarded as an indication of infection. Cooledge[1] (1916) considered that the milk agglutination test, using whey, was of value in determining *B. abortus* infection, but in a later article of the same year[2] observed that there was no constant relationship between the antibody content of the blood and the milk of infected cows, since the titre of milk may vary from quarter to quarter of the same udder. Schroeder and Cotton[13] (1917) drew attention to the high agglutinating power of colostrum, and the secretion from the almost dry udders of infected cows. Robinson[12] (1918), while observing much fluctation in titre tests with whey, believed that whey might be used as a medium through which infection could be detected, but that the test was unnecessary other than as a control on the blood test. He noted that the whey from the udder secretion of infected cows when almost dry possessed a particularly high agglutinin content —even exceeding that of the serum. Smith, Orcutt and Little[16] (1923) found that, as regards the agglutinin content of milk, there were two types of infected cows: those in which the ratio between the titre of whey and that of serum is as 1 : 16 to 1 : 64, and those in which the ratio is as 1 : 1 to 1 : 4. They observed that in the case of colostrum the ratio is 2 : 1 to 1 : 1, and ascribe this to an accumulation, since the titre of whey rapidly falls as lactation becomes established. Sheather[15] (1923) examined for agglutinins the milk of fifty cows positive to the blood test. In more than 14 per cent. of these cases the whey failed to give a positive reaction. It was concluded that whey was not a suitable substitute

for a serum, and that the relationship between the agglutinin content of whey and serum was not constant. Quinlan[10] (1923) found that the milk of infected cows sometimes showed vastly different agglutination titres when tested at intervals of a few months, while the serum reactions remained more or less constant. McAlpine and Rettger[6] (1925), testing by the agglutination and complement fixation tests the whey from the milk of cows reacting to the blood test, concluded that such animals may be divided into three main groups. "One of these groups comprises animals whose udder secretions constantly exhibit reacting bodies of both classes. The second is made up of cows in the milk of which the so-called immune bodies are present only during the colostral and drying-off periods; while in the third group the complement fixing bodies are never present in the milk." Leinhardt, Kitselman and Sawyer[5] (1923) observed that in only 50 per cent. of cows positive to the blood test did the milk give a positive reaction when obtained immediately after the birth of a calf or the occurrence of abortion. Poppe[9] (1929) stated that: "the examination of milk for antibodies has only a limited value, and is of secondary importance in the serological diagnosis of bovine infectious abortion." Graham and Thorp[3] (1930) compared the reactions in blood and milk agglutination testing of two herds of 91 and 81 animals respectively. In each test complete agglutination at 1/200 was regarded as positive, and at 1/50 as doubtful. In the herd of 91 animals, 84.62 per cent. of the blood and milk samples gave results in agreement. Of the fourteen disagreements, the milk test was negative and the blood test positive in thirteen, the remaining cow reacting in milk only. In the second herd 74.07 per cent. of the results were in agreement. Of the twenty-one disagreements, all were accounted for by non-reaction to the milk test in cows reacting in blood. Karsten[4] (1931) found that in twenty-eight cows positive to the blood test, agglutinins could be detected in the milk of twenty-six. As a rule the milk titre was ten times lower than the blood titre. In further work he took as a positive reaction agglutination at 1/100 in the case of blood, and at 1/10 in the case of milk. Agglutination at 1/50 and 1/5 respectively he regarded as doubtful. He compared the reactions in 123 cows which had aborted in the previous year, and 154 cows which, while exposed to infection, had calved normally during that period. Of the cows giving a positive blood test, 86 per cent. were also positive in milk. The blood alone was positive in thirty-four cows, and the milk alone in fifteen. In twelve of these cases in which the milk reaction was negative the blood serum titre was 1/100, and in fourteen cases 1/200. In the eight remaining cases the serum titre was much higher. In the fifteen cases in which the blood serum reaction was negative and the milk reaction positive its titre was 1/10 in ten cases, 1/20 in three cases, and 1/40 in two cases. Karsten concluded that neither the blood nor the milk test is individually efficient, and that his results suggest that the two tests should be employed in cases of doubt.

In an attempt to assess the practicability of the segregation method of controlling contagious abortion in herds located in North Wales, one of the major factors mitigating success has been the failure of the blood serum agglutination

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test to detect relatively recently infected cows before they became active spreaders of infection. The writers have recorded[8] six cases from one herd in which non-reacting cows suddenly became reactors shortly after calving. Similar cases have been encountered in other herds, together with instances of abortion even within one month of a negative blood test. Since some of the agglutinins present in milk certainly have their origin in the udder tissue, it appeared possible that in at least some of these instances infection might have been detected by a test of the milk. The only means available to the writers for the investigation of this possibility was the repeated testing of simultaneously taken blood and milk samples from the cows of several herds in which contagious abortion was spreading. It was expected that in this way an occasional recently infected in-calf cow would be encountered. It was, therefore, convenient to run together a comparative investigation of the blood and of the milk agglutination test, and observations on the value of the milk test as a means of detecting recently infected animals.

Much preliminary work was carried out to determine the most suitable methods to standardise in the testing of milk samples for agglutinins. The most satisfactory means of obtaining a clear whey was the drawing off of about 30 c.c. of milk directly into a tube containing approximately 0.25 gms. of powdered rennet, and immediately shaking to mix. This method was suggested by Dr. J. P. Torrey, of Michigan State College, in a private communication. Milk taken in this manner coagulates before the cream has time to rise, and after standing overnight generally gives an almost water-clear whey. It appeared that wheys from fore-milk, middle-milk, or from strippings, were satisfactory, and had an approximately equal agglutinin content. A composite sample of the milk of a number of known clean and known infected cows was submitted to the agglutination test as practice in the setting up and the reading of whey tests, and to determine standards indicative of infection and freedom therefrom. The formation of particles or flocculi, bearing no relationship to true agglutination tended to occur during incubation in testing a proportion of the wheys. This created some difficulty in reading these tests, but with practice it became easy to distinguish it from true agglutination. That records of milk tests might readily be distinguished from those of blood tests, unusual symbols were employed in recording the former. The symbol "C" was chosen to indicate easily appreciable agglutination—large clumps of bacteria with much clearing of the supernatant. A small letter "c" was used to designate agglutination to small clumps with only a little clearing of the supernatant. It was appreciated that the symbol "C" did not always represent the same degree of reaction in that it was applied alike to tubes in which the supernatant was water clear and to others in which a varying but small proportion of the organisms remained in suspension. The dilutions of whey selected for testing of milk samples were: 1/5, 1/10, 1/20, 1/40 and 1/80; the amounts of whey being 0.2 c.c., 0.1 c.c., 0.05 c.c., 0.025 c.c., and 0.0125 c.c. The final volume in each tube was 1 c.c. The standards adopted and retained throughout this investigation were: reactions down to C at 1/10—positive; reactions of C at 1/5, but not at 1/10—doubtful; reactions less than C at 1/5—negative.

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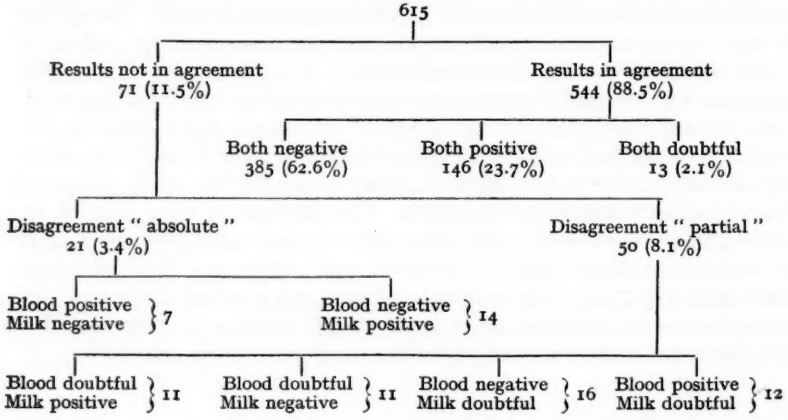
The dilutions of serum used in the testing of blood were: 1/20, 1/40, 1/80, 1/160 and 1/320; the amounts of serum being 0.05 c.c., 0.025 c.c., 0.0125 c.c., 0.00625 c.c., and 0.003125 c.c., and the final volume in each tube 1 c.c. The symbol " + " was chosen to indicate complete agglutination, and " A.C." to represent almost complete agglutination, the supernatant being slightly cloudy. The standards adopted in these tests were: reactions down to + at 1/40 with AC at 1/80—positive; reactions of AC at 1/40 with + at 1/20—doubtful; reactions less than AC at 1/40—negative.

The bacterial emulsion used as antigen was prepared from a readily agglutinable strain of *B. abortus*, and standardised to an opacity between tubes No. 1 and No. 2 of the McFarlane nephelometer scale. The tests were incubated at 37° C. for twenty-four hours, and stood at room temperature for a further period of twenty-four hours. They were read on removal from the incubator, and again after standing, the latter reading being the critical one.

During the period May 29th, 1931, to January 30th, 1932, the writers have, where possible, obtained on that day a sample of milk from each cow whose blood was taken to be submitted to the agglutination test for the detection of *B. abortus* antibodies. The blood samples were generally obtained from the subcutaneous abdominal (milk) vein, occasionally from the jugular. The milk samples were composite, an approximately equal amount of milk being drawn from each teat. The majority of the samples were obtained in herds in which periodic testing has been practised. In animals of special interest repeated examinations of the blood and milk have been made. Samples were obtained on one or more occasions from 314 cows. The history of all these animals was known, the blood of very many having been previously submitted to one or more agglutination tests. The tests were read and their indication noted by one or other of the writers: when practicable the serum reactions by one and the whey reactions by the other. The number of comparative blood and milk samples obtained during this period was 615, and the result of their examination, according to the methods and standards described above, may be summarised as follows:—

NUMBER OF INSTANCES IN WHICH COMPARATIVE SAMPLES OF BLOOD AND MILK WERE TESTED.



In twenty-one of the instances in which the results did not agree, the disagreement was "absolute," in that one of the tests gave a positive reaction, whereas the other was negative. In the remaining fifty the disagreement was "partial," as one or other of the tests gave a doubtful result. An attempt to determine which result was reliable, or the more reliable, has been made by a search of the history, breeding and agglutination reaction in previous and subsequent blood tests, of the cows from which these samples were obtained. It will be appreciated that in a number of cases the indication obtained was insufficient to permit a decision as to whether the cow was infected or not *at the time of the test.* The following table sets out these disagreements, and shows which test appeared to give the correct indication as to infection :

TABLE No. I.

Type of Disagreement.	Number of instances. Total.	Blood reaction probably correct.	Milk reaction probably correct.	Insufficient evidence.
Blood positive ... Milk negative ...	7	7	*Nil*	*Nil*
Blood negative ... Milk positive ...	14	9	2	3
Blood doubtful ... Milk positive ...	11	3	4	4
Blood doubtful ... Milk negative ...	11	5	1	5
Blood negative ... Milk doubtful ...	16	7	4	5
Blood positive ... Milk doubtful ...	12	11	*Nil*	1
Totals	71	42	11	18

In the above table samples from certain cows appear on more than one occasion, since occasional instances of repeated disagreement have been encountered. The results in testing two cows serve as outstanding examples of this :

Delilah.—Due to calve 10/2/31, but proved barren. Reserved a number of times thereafter. Settled to service 5/9/31.

8/12/30	Blood 1/20	—(negative)
3/2/31	Blood 1/20	—(negative)
9/6/31	Blood 1/160	+(positive)
	Milk 1/5	C (doubtful)
9/7/31	Blood 1/160	+(positive)
	Milk 1/10	C (positive)
20/8/31	Blood 1/80	+(positive)
	Milk 1/5	C (doubtful)
22/10/31	Blood 1/80	+(positive)
	Milk 1/5	C (doubtful)
12/1/32	Blood 1/160	+(positive)
	Milk 1/10	C (positive)

Queen.—Calved 4/4/31. Served 23/5/31.

8/12/30	Blood 1/20	—(negative)
3/2/31	Blood 1/20	—(negative)
9/6/31	Blood 1/80	+(positive)
	Milk 1/5	C (doubtful)
9/7/31	Blood 1/80	+(positive)
	Milk 1/10	C (positive)
20/8/31	Blood 1/80	+(positive)
	Milk 1/5	C (doubtful)
22/10/31	Blood 1/40	+(doubtful)
	Milk 1/5	c (negative)
12/1/32	Blood 1/80	+(positive)
	Milk 1/80	C (positive)

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All of the blood positive-milk negative disagreements occurred in samples from cows believed infected, generally at a time when the blood titre was low. In two instances, however, the blood titre was 1/160. Six of the cows had recently become infected, and in one infection was of old standing. Of the nine instances in which the disagreement was blood negative-milk positive, and the cow *not* infected, six occurred in animals almost dry. The whey from the udder secretion in these cases generally reacted in high titre. In one of the remaining instances the whey was obtained from colostrum. Where the wheys gave a correct indication the cows were recently infected animals. In the three instances of blood doubtful - milk positive disagreement in which the cows proved non-infected, the milk had been obtained from an almost dry udder. In the four instances in which the milk test appeared to give the correct indication the cows had become recently infected as they reacted to subsequent tests. Of the six instances of blood doubtful-milk negative disagreement in which sufficiently definite histories were available, the blood reaction gave the more correct indication in five, all recently infected. The cow whose milk gave a negative reaction was negative to the blood test also at two subsequent tests. The history in eleven of the sixteen blood negative-milk doubtful disagreements was sufficient to point to the blood reaction being correct in seven instances, and the milk in four. The incorrect indications from the whey test appeared to be associated with the drying-off of the cows. Four milk doubtful reactions occurred in cows which subsequently reacted to both tests. In all the eleven instances in which the correct indication was obtainable after a blood positive-milk doubtful reaction, the reaction to the blood test appeared correct. In five of these the blood reaction was high (+1/160 or +1/320) and in six low (+1/80). In five the infection appeared to be of recent date, and in six it was of some standing.

In eighteen instances the whey test was not positive when the cow at that date reacted to the blood test, and apparently was infected. In six instances the blood test did not give a positive reaction when the cow at that date reacted to the whey test, and apparently was infected.

During the period of these observations, forty-one clean cows became reactors in herds undergoing routine testing, but were detected before they calved or aborted. Thirty of these cows gave positive milk reactions on the occasion of the first blood-positive reaction. Eight cows gave positive reactions to blood while the milk reaction was still negative or doubtful, and three were positive in milk, while the blood reaction was still doubtful or negative. These eleven cows later reacted to both tests before calving or aborting.

Eleven cows which were believed to be clean aborted within six weeks of their non-reaction to the blood test. The history of these cows is briefly set out in the accompanying Table No. II. It will be seen that both the blood and milk tests immediately preceding the abortion were negative in seven of these cases, although in two a previous blood test gave a doubtful reaction. In one, Megan, at the test previous to the abortion the blood was doubtful and the milk negative.

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Table No. II.

Histories of Eleven Cows which Failed to React to the Blood Test Prior to Abortion.

	L 21	Bluebird	107	92	113	86	Nina	Gwyneth	201	L 26	Megan
15.5.31	B. 1/40+	—	B. 1/20—	B. 1/20—	B. 1/20—	B. 1/20—	—	—	—	B. 1/20 A.C.	—
	M. ———	—	M. ———	M. ———	M. ———	M. ———	—	—	—	M. ———	—
5.6.31	B. 1/20+	B. 1/40+	—	—	—	—	—	—	B. 1/20—	B. 1/20—	—
	M. 1/5 c	M. 1/5—	—	—	—	—	—	—	M. 1/5—	M. 1/5 C. 1/10 c	—
6.7.31	B. 1/20 A.C.	B. 1/20 A.C.	B. 1/20—	B. 1/20—	B. 1/20—	B. 1/20 A.C.	B. 1/20—	B. 1/20—	—	Aborted	B. 1/20
	M. 1/5 c	M. 1/5 c	M. 1/5—	M. 1/5—	M. 1/5—	M. 1/5 C	M. 1/5—	M. 1/5—	—	(twins)	M. 1/5—
12.7.31	—	Aborted	—	—	—	—	—	—	—	B. 1/320+	—
	—	—	—	—	—	—	—	—	—	M. 1/80 C.	—
20.7.31	—	B. 1/80+	—	—	—	—	—	—	—	—	—
	—	M. 1/20 C	—	—	—	—	—	—	—	—	—
29.8.31	Aborted	—	—	—	—	—	—	—	—	—	—
4.9.31	B. 1/80+	—	B. 1/20+	B. 1/20—	B. 1/20—	B. 1/20—	B. 1/20—	B. 1/20—	B. 1/20—	B. 1/320+	B. 1/20—
	M. 1/80 C.	—	M. dry	M. 1/5—	M. 1/5—	M. 1/5—	M. 1/5—	M. 1/5—	M. 1/5—	M. 1/80 C	M. 1/5—
17.9.31	—	—	—	—	—	—	—	Aborted	—	—	—
25.9.31	—	—	—	—	—	—	Aborted	—	—	—	—
30.9.31	—	—	—	Aborted	—	—	—	—	—	—	—
3.10.31	—	—	—	—	Aborted	Aborted	—	—	—	—	—
22.10.31	—	—	Aborted	—	—	—	—	—	—	—	—
9.11.31	—	—	—	—	—	—	—	—	—	—	Aborted
17.12.31	—	—	B. 1/320+	B. 1/320+	B. 1/320+	B. 1/160+	—	—	B. 1/20+	—	—
	—	—	M. 1/80 C.	M. 1/80 C.	M. 1/80 C.	M. 1/5—	—	—	M. 1/20 C 1/40 c	—	—
24.1.32	—	—	—	—	—	—	—	—	Aborted	—	—

Cow L26 was negative to blood and doubtful to milk four weeks prior to abortion. Cow 201 was negative to blood and positive to milk five weeks prior to abortion. In the remaining cow, a milk sample was not available at the test four weeks before she aborted.

Discussion.

There is no general adoption of one standard of serum agglutination reaction as indicative of infection. The level chosen by the writers would be considered by some as low, and by others as likely to miss infected cows occasionally. Its adoption for this investigation was based particularly upon experience in the periodic blood testing (three or more tests) at this laboratory of some 300 cows of known history which were followed through one or more periods of gestations. The choice of reactions down to easily appreciable agglutination by whey at 1/10 (0.1 c.c. of whey in a total volume of 1 c.c.) as indicative of infection, may appear a severe standard, particularly since some workers have not included tubes of such low dilution in their tests. It is, however, a standard very similar to that chosen by Karsten. Since 401 of 415 milk samples from cows whose blood test of the same date was negative did not react at this level, it would seem that whey from the milk of clean cows rarely agglutinates at 1/10.

The 88.5 per cent. agreement between the results of the two tests suggests that they were almost equally accurate. The data contained in Table No. I, however, makes it obvious that failure of the whey test to give the correct indication was responsible for the majority of the disagreements. The basis on which the writers have had to decide which test gave the correct indication is, however, open to question. Although it may be perfectly sound to regard all cows which have only recently become reactors to the blood test as infected, it certainly could not be contended that all reactors of some standing are still infected. It may well be that some of the instances in which the blood test gave a positive result while the milk test was negative occurred in animals which had overcome infection. Of this the writers have no evidence, and it has seemed more satisfactory for present purposes to regard all cows giving a positive reaction to the blood test as infected. This point is, however, worthy of special investigation, for it may be that, at least in animals not in-calf, when there is a history of positive blood reaction of some standing and the whey reaction is negative, the indication is that the animals have overcome infection.

This investigation appears to have brought to light one point not hitherto appreciated. The high titre reaction of whey from the udder secretion of almost dry infected cows has been noted previously, but, so far as the writers are aware, high titre reactions in the whey of this material from the udders of clean cows has not hitherto been observed. The writers are not at the moment prepared to suggest any explanation of this reaction, nor have they sufficient data to determine whether it is of regular occurrence. It is one of the points regarding the testing of whey to which they propose to give further attention, but it does seem that these reactions place the testing of whey at a serious disadvantage. With

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their present knowledge, the writers would place no reliance on reaction in the whey test of animals near the end of their lactation period.

So far as the comparative value of the two tests in the detection of recent infection is concerned, the evidence obtained during this investigation is rather meagre. It has been noted that of forty-one new reactors detected in routine herd testing before the termination of their pregnancy, a positive reaction appeared for the first time simultaneously in blood and in milk tests of thirty, while in eight the blood reaction was the first to become positive, and in three a positive reaction first appeared in the milk test. The incidence of failure of the blood test to detect infection before the cow became a dangerous spreader of the disease by aborting has, during the period of observation, been particularly high. It must, however, be emphasised that the writers were working in herds in which the disease was advancing, and that the eleven cases are spread over four herds. A test of the milk of ten of these cows was made on the occasion of the blood test immediately preceding the abortion. In eight it was negative, in one doubtful, and in one positive, while in one instance in which the blood test did give a doubtful reaction the milk was still negative. On this evidence it would appear that the testing of milk is rather less likely to pick out recent infection, but that it may occasionally succeed where the blood test fails, and for this reason some advantage does attach to the simultaneous testing of blood and milk.

While reliability is the criterion on which one must judge these tests, it is obvious that other advantages and disadvantages attach to them. The testing of milk has the great disadvantage that it is not practicable in in-calf heifers and in dry cows. Its advantage over the blood test lies in the ease with which milk samples are obtainable. For this reason it seems that the testing of milk might be utilised as a means of more frequent testing, without unduly increasing the costs in herds in which the segregation method of control is being practised.

Summary.

(1) In 615 instances comparative blood and milk samples from 314 cows of known history were submitted to the agglutination test for the detection of *B. abortus* antibodies.

(2) The results in testing the serum and the whey from these samples were in agreement in 544 instances (88.5 per cent.) ; 385 negative reactions ; 146 positive reactions ; and 13 doubtful reactions.

(3) In 53 of the 71 disagreements the history of the cow, breeding, and reaction to previous and subsequent tests, were sufficient to indicate whether or not she should be regarded as a reactor. The blood test had given the correct, or the more correct, indication in 42 instances, and the milk in 11. When only one test gave a positive reaction in apparently infected cows, the reaction occurred in blood in 18 instances and in milk in six.

(4) Among the disagreements occasioned by the milk test being positive or doubtful when the cow was not infected, 16 appeared to be attributable to the testing of whey from the secretion of an almost dry udder.

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(5) Of 41 cows which during the period of observation became reactors in herds in which periodic testing was being carried out, 30 gave a positive reaction to milk on the occasion of the first blood positive reaction. Of the 11 remaining cows in this group, eight reactions in blood and three in milk occurred while the corresponding test was still negative.

(6) In 11 cows, abortion occurred within six weeks of non-reaction to the blood test. On the occasion of the test prior to abortion, a doubtful blood reaction was observed in one, a doubtful milk reaction in one, a positive milk reaction in one, and in one milk was not available for test purposes. In the milk test of the remaining seven cows, a negative result was recorded.

Acknowledgment.—It is a pleasure to acknowledge here the assistance of the Imperial Bureau of Animal Health in reviewing the literature on this subject.

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STUDIES OF FOWL PARALYSIS.

III.—Gastronomic Enteritis.

By W. P. BLOUNT, F.R.C.V.S.

Poultry Pathological Research Laboratory, Goring, Reading.

IN a previous paper (1931) presented to the Surrey County, 1931, Poultry Conference, the writer suggested that an improper functioning of the gizzard played a highly important part in the study of the causation of paralysis in the domestic hen. Briefly recapitulated, his hypothesis and supporting arguments were as follows :

In practically every case of paralysis affecting young birds between the ages of three and eight months, an inflammation of the small intestines is noticeable on post-mortem examination. This is most marked in the duodenum, which may be characterised by numerous petechiæ, fine pin-point hæmorrhages, catarrh or hyperplasia with or without bile staining. These features suggested that the gizzard, because of its anatomical relationship, might provide a clue as to the

identity of the enteritis. Such proved to be the case, because, apart from gross abnormalities such as impaction, hypertrophy with definite loss of muscular control, ulceration, etc., the majority of the gizzards failed to exhibit grit in their contents. This at first appeared an extraordinary feature, because the birds were quite definitely supplied with ample grit—limestone grit of the finest quality. It was soon, however, realised that the explanation for this apparent mystery was due to the fact that the grit supplied contained $CaCO_3$, and as such was soluble in the gastric acids. Limestone grit is advertised as consisting of 99 per cent. calcium carbonate, whilst ground oyster-shell (meal) contains about 77 per cent. calcium carbonate. It is probable that not more than 15 per cent. of the constituents of oyster-shell are insoluble in the gastrice juices, chief of which constituents is silica 14.05 per cent. (*The Fertiliser, Feeding Stuffs and Farm Supplies Journal*, 1929). A knowledge of chemistry is not necessary to confirm this statement, because the practical poultry breeder knows from experience that the modern hen, laying up to 300 odd eggs per year, needs more lime than she can receive from an ordinary ration of wheat and maize. Limestone grit, amongst other substances, supplies this deficiency, and if neglected is followed by the production of soft-shelled eggs. Under modern feeding conditions it is highly probable that this deficiency of lime is far less acute than is usually supposed. Rations containing alfalfa, clover meal, fish meal, meat and bone meal, or sterilised bone flour, would certainly appear to contain sufficient calcium for growing chicks, and frequently enough for laying hens. It is clear that whilst supplying lime for egg-shell production, such " grit " cannot perform adequately the grinding process in the gizzard.

For many years it has been known that graminivorous birds swallow grit, which passes to remain in the gizzard, there to be used in place of " teeth " —so noticeably absent in aves—for the crushing and grinding of semi-solid food particles. The very powerful muscles of the gizzard are arranged characteristically, a conformation adapted to the function of the organ as a mill. In colour the muscles are red, which suggests that they are under the control of the will, but histologically it is noted that individual muscle fibres are non-striated, and as such, involuntary. These two characters place the organ in the same category as the heart, with which structure the gizzard is further allied because of its automatic rhythm. Some idea of the crushing action of the gizzard may be gained from the statement of Smith, who says that a piece of iron tubing capable of supporting 535 lb. weight was distorted when introduced into the gizzard of a turkey. However, in spite of this fairly obvious and very essential function of the non-glandular stomach (gizzard) of the domestic hen, certain workers believe that no grit is required, while others have suggested that limestone or oyster-shell grit will suffice. Such suggestions are received by the lay poultry keeper *via* the press as authoritative, and consequently from economical grounds alone he puts them into practice.

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The result has been that we now find birds reared intensively for several weeks either with a complete absence of grit, or with equally valueless grinding materials such as " fossils," " charcoal grit," oyster or cockle shells, or limestone grit. Each of these substances, after varying periods of time, disappear from the gizzard by solution or maceration, and incomplete grinding of foodstuffs occurs. The result, in the writer's opinion, has been disastrous, in that the subsequent indigestion and malnutrition in birds has been followed by an inflammatory reaction in the duodenum which predisposes the digestive tract to internal parasitosis. This enteritis is probably caused by the passage of improperly ground foodstuffs (notably fibrous, cellulose-containing materials) into the duodenum. A mechanical irritation of the intestinal villi occurs, which may possibly be aggravated by an excess of calcium (derived from calcium carbonate interacting with gastric acids), and/or decomposition food products. A repetition of this process would undoubtedly lead to the production of chronic enteritis. Such loss of intestinal vitality presumably preparing the way for the breeding and multiplication of parasites, *i.e.*, davainea, heterakis, ascaridia, or eimeria.

The theory appeared to hold good in the study of fowl paralysis, because unquestionably an inflammation of the intestines does exist in this disease, and in the majority of cases an intestinal parasitosis is an accompaniment. It has been shown in another publication (Hamilton and Blount, 1931) that there is no one specific parasite present in cases of fowl paralysis, but in our experience a very large proportion of cases do exhibit some internal helminth or protozoan parasites in abnormal numbers. The original hypothesis has been amply confirmed, and an analysis of the data relative to fowl paralysis collected at the above laboratory is as follows :—

Fifty outbreaks of paralysis have been investigated, and more than 100 post-mortem examinations carried out. Information has been acquired by means of printed forms which contain questions relative to the source of origin of the eggs ; methods of feeding, housing, and rearing, both chicks and pullets ; symptoms, etc. Where answers have appeared unsatisfactory, further correspondence has followed, and even farms have been visited.

From Table I it can be seen that 90 per cent. of the cases of paralysis have occurred on farms where either no grit or soluble grit has been used. This statement might have little significance in some people's eyes, because it is generally believed that where birds have access to free range by being reared extensively, or only semi-intensively, there is no reason to supply grit for grinding purposes, the natural soil providing an adequate supply of stones of suitable size. Unfortunately this is untrue, because the writer has repeatedly demonstrated by post-mortem examination that such birds can possess gizzards completely devoid of grit. The explanation is apparently two-fold : (1) Heavy clay or chalky soils frequently contain little suitable grit, which factor becomes accentuated when either (*a*) birds are repeatedly penned or reared on the same pieces of land ; or (*b*) when the " range " offered to a bird is limited in extent. (2) The presence

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TABLE I.

Case.	Type of Grit.	Type of Rearing. Intensive	Semi-Intensive	Type of Soil.
AC.	Limestone	+	—	—
CR.	Oyster	—	+	Clay
DO.	Lime and oyster	—	+	Fairly heavy, runs well limed
HO.	None, then oyster	+	—	—
JA.	Oyster and Fossils	+	—	—
HU.	Oyster after ten days	—	+	Heavy clay soil
RU.	None	—	+	Mixed clay
SO.	Limestone	—	+	Loam, clay under soil
SP.	Oyster	+	—	—
TIE.	Cockle	+	—	—
TIA.	Oyster	+	—	—
TU.	Fine oyster	—	+	Semi-clay
WA.	Oyster	+	—	—
WR.	Oyster	+	+	Limestone
DE.	None	+	—	—
CH.	None	—	+	?
DU.	Fine flint for two weeks, then lime	+	—	—
SH.	Fine oyster, then none	—	+	Heavy clay
ME.	Sand, then none	+	—	—
WI.	None	+	—	—
HE.	None	+	—	—
CA.	None	+	—	—
LE.	None	+	—	—
TA.	Lime and Flint	—	—	—
PR.	Oyster	+	—	—
PH.	Limestone	+	+	Black Fen Land.
NI.	Limestone	—	+	Heavy
PO.	Chargrit	+	—	—
TI.	None	—	—	—
WAC.	Limestone	+	—	—
HOD.	Flint sometimes, then shell	+	—	—
VI.	Flint	—	+	Loam
WAT.	None	—	+	Rather heavy
WO.	Flint and oyster	+	—	—
HD.	None	+	—	—
CAR.	None	+	—	—
WIL.	Oyster	+	—	—
SM.	Lime, little flint as well	+	—	—
PE.	Limestone	+	—	—
McC.	Oyster	+	—	—
WAS.	Ground cockle	+	—	—
SW.	Fine cockle, little eaten	—	—	—
HUD.	Limestone	+	—	—
POT.	None	+	—	—
TID.	None	+	—	—
AL.	None	+	—	—
RI.	Lime or fine oyster	—	—	—
NO.	None	+	—	—
BA.	None	+	—	—

Questionnaire results : Nine cases of paralysis.
6 cases no grit. 3 cases oyster-shell grit. 7 cases intensively reared, 2 cases semi-intensively.

of lime or other soluble calcium salt in a mash depresses a bird's natural appetite for grit intake.

Out of fifty outbreaks investigated, in only one instance was pure flint grit fed to the birds; two farmers fed flint and limestone mixed, and two other farmers supplied flint with oyster-shell. The high calcium content of lime and oyster grits both tend to depresss the intake of flint or natural grit. Therefore it can be seen that more than 90 per cent. of cases of epizootic paralysis in hens are associated with incorrect attention to the requirements of the gizzard of chicks during the intensive brooding period.

It may be noted (Table I) that where birds have become paralysed after being reared semi-intensively, in every case the type of soil or general conditions under consideration have been such as would be unlikely to supply a number of growing birds with adequate quantities of grit.

Of the fifty paralysis cases recorded, we have demonstrated macroscopically an enlargement of one of the limb nerve plexuses in nineteen instances. The majority of these outbreaks have been complicated by an intestinal parasitosis, but it is perhaps significant that those animals receiving flint grit failed to exhibit such parasitic infestation.

Conclusions.

From a study of fifty outbreaks of paralysis (affecting several hens in each flock) including nineteen exhibiting nerve lesions, it has been found that at least 90 per cent. of these cases were associated with an improper functioning of the gizzard due to a deficiency of insoluble grit, like flint, in the diet. Inflammatory changes occurred in the alimentary canal, notably in the duodenum, and in the majority of instances intestinal parasitosis followed. In the study of the prevention of the disease, fowl paralysis, and also of associated paralyses exhibiting as their sole feature numerous intestinal parasites, careful consideration should be given to the management of such birds throughout life in order to ensure that grit suitable for the optimum functioning of the gizzard shall be supplied at all times to be ingested by these animals. Except in the case of birds occupying light "gravel" soils, flint grit should be broadcast over the land periodically. Care should be taken to ensure that a bird's natural appetite for grit does not become dull because of the presence of an excess quantity of soluble calcium salts in the ration. It is suggested that birds reared intensively without a proper supply of grit suitable for grinding purposes, or reared on range inadequate in this respect, prepare themselves for future intestinal parasitic infestations by lowering the vitality of their digestive tracts.

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BLOOD-TESTING AND EGG-PRODUCTION.

By P. L. SHANKS, B.Sc., M.R.C.V.S., and J. M. GORDON, B.Sc.
Ministry of Agriculture, Northern Ireland.

MANY poultry farmers who maintain flocks for egg production for purposes other than hatching are debating the advisability of having their flocks blood tested for the detection of bacillary white diarrhœa carriers. Some assert that blood testing is only necessary when a flock is maintained solely for breeding purposes, despite the fact that various authorities (1, 2, 3, 4, 5, 6, 7, 8 and 9) have shown that B.W.D.-free flocks give a better yearly egg production than flocks which contain B.W.D. carriers. In this connection, the statistics given below from an egg-laying trial are of interest.

At the completion of the laying test under review, all the birds were submitted to the agglutination test to detect any B.W.D. carriers, and those pens which showed the presence of one or more reactors were selected for analysis.

TABLE I.

No. of Bird.	Number of eggs laid during test.	Result of Agglut. test.	Remarks.
A1	200	Negative	
A2	245	Negative	
A3	224	Negative	
A4	122	Positive	
A5	251	Negative	
A6	50	Positive	Did not lay before after sixth period.
A7	242	Positive	
A8	178	Positive	
A9	201	Negative	
A10	219	Negative	
A11	64	Positive	Did not lay after seventh period.
A12	117	Positive	
A13	178	Positive	
A14	250	Negative	
A15	108	Positive	Did not lay after ninth period.
A16	101	Positive	
A17	185	Positive	
A18	194	Negative	
A19	219	Negative	
A20	199	Negative	
A21	177	Negative	
A22	219	Negative	
A23	62	Positive	Did not lay after eighth period.

TABLE I—*continued.*

No. of Bird.	Number of eggs laid during test.	Result of Agglut. test.	Remarks.
A24	236	Negative	
A25	182	Negative	
A26	227	Negative	
A27	188	Positive	
A28	208	Negative	
A29	176	Negative	
A30	170	Negative	
A31	127	Positive	Did not lay after seventh period.
A32	161	Negative	
A33	179	Positive	
A34	225	Negative	
A35	158	Negative	
A36	143	Positive	Did not lay after ninth period.
A37	178	Negative	
A38	199	Negative	
A39	194	Positive	
A40	172	Positive	

All birds in the above table were of similar breed.

Egg recording covered twelve periods of twenty-eight days.

All positive reactors gave complete agglutination in one in twenty-five dilution.

TABLE II.

Group.	Number of birds in group.	Total number of eggs laid.	Average number of eggs laid per bird during trial.
Non-reactors	23	4,710	204.8
Reactors	17	2,410	141.8

Discussion.—It will be seen from Table II. that there is a marked difference in the average egg yields in favour of non-reacting birds. Only birds which appeared in good health throughout the whole period of the test were included in the tables. One bird, A41, was ruled out on this account. This bird died at the end of the eighth period, having laid five eggs during that time, *i.e.*, during eight months. *B. pullorum* was isolated from her ovaries.

The average egg yield for all birds taking part in the trial, excluding those which died, was 197. This average is seven less than that of the non-reacting birds, and fifty-five more than the reacting birds in the pens under review.

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Conclusions.—Practical results have shown that, by means of the blood test, carrier birds can be detected and removed from the breeding flocks, and thus outbreaks amongst young chicks have been prevented. From the above tables it would appear to be well worth while to apply the same procedure to birds destined solely for commercial egg production.

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FOWL PARALYSIS IN CYPRUS.

By F. H. MANLEY, B.V.Sc., M.R.C.V.S.

Agricultural Department, Cyprus.

INTEREST in this disease has recently been stimulated in English veterinary literature by the articles by McGaughey and Downey[1] (1930), and Bayon[2] (1931). The incidence of the disease is apparently on the increase in England, and it occurs in many other countries. It has recently been observed in Nigeria by Hall.[3] Accounts of previous observations on the disease in Austria, Holland, the United States, Germany and England, have been recently briefly reviewed by Bayon (1931). Only one small outbreak has been brought to our notice, but as the disease is now under investigation in England, the recording of our observations may be of interest.

The outbreak mentioned occurred on the Government Stud Farm, Athalassa. The disease was confined to a flock of Red Sussex, consisting of six cocks, twenty hens, ninety-five cockerels, and seventy-seven pullets. They were divided into six adjacent pens. The disease has so far only been observed in two pens, which contain eighteen cockerels and fourteen pullets. The land on which the flock is penned has only recently been stocked with poultry. All poultry on the farm

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receive similar rations, which include green lucerne. There are several other breeds of poultry on the farm, but none have so far shown any signs of developing the disease. All the birds in the infected flock were hatched in Cyprus from imported birds. The latter have not developed the disease. The ages of the infected birds ranged from four to seven months. This observation appears to agree with that recorded by other workers.

Symptoms.—The course of the particular outbreak of the disease recently described by Bayon (1931) was apparently acute, and differed in this respect from that which has hitherto been described by other authors. The cases under observation here are certainly more chronic in nature, and usually take several weeks to run their course. Apparently the first noticeable sign of the disease is a slight turning outwards of the foot. The birds then show signs of weakness in the legs, and the toes and feet may be continuously flexed. Later the birds rest frequently on the breast bone, and when disturbed the gait is slightly ataxic. In the acute outbreaks described by Bayon (1931), only one leg was paralysed in each case observed, but in all cases which have been examined here, both legs have been affected. In the later stages of the disease the birds rest continuously on the sternum. One or both legs may be extended backwards. The wings then droop to the ground. Torticollis has not been observed, nor have any of the affected birds suffered from iritis. Some conjunctivitis has been observed in a few cases. The appetite appears to be good until the advanced symptoms interfere with prehension. It would appear that under natural conditions birds which develop advanced symptoms rarely recover. Mild cases do occur, and in these cases recovery is possible, although the apparent weakness in the legs may persist for some time. An American investigator, Stafseth[4] (1931), has recently stated that recovery seldom takes place. Four out of fifteen infected birds observed here have apparently completely recovered.

Post-Mortem Notes.

Fowl No. 1.—Red Sussex cockerel. The carcase was emaciated, and the crop empty. The sternum was bent. This feature was noted in other cases, and is presumably caused by the continuous resting on this bone which occurs in advanced cases. The leg muscles appeared atrophied and the left leg as extended backwards. The extension backwards of one or both legs also appears to be characteristic of the late stages of the disease. The comb, wattle, and eyes in this case were normal. The internal organs appeared to be normal, except for a congestion of the mucous membrane of the small intestine. There was a mild tape-worm infestation, and a few Heterakis in the cæcum. There were no coccidia present. The nervous system appeared to be normal. The bones cut very easily, and the medulla of the long bones was congested.

Fowl No. 2.—Similar to No. 1, except that there was an enlargement of the spinal cord on the right side near the brachial plexus, and no congestion of the small intestines.

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Fowl No. 3.—There was no twisting of the legs in this case, and no tænia present. Spinal cord, brain, and internal organs normal.

Fowl No. 4.—The carcase was emaciated, but all organs appeared macroscopically to be normal, except that there was a gelatinous-like exudate on the superior surface of the cord in the sacral region.

Fowls Nos. 5 *and* 6.—The same as No. 4, except that tænia were present in No. 6.

Fowl No. 7.—There was a considerable amount of enteritis present throughout the intestines. The liver was congested, and the spleen appeared to be small in size. The nervous system appeared to be normal. No parasites were observed.

Histology.

The following notes have been forwarded to me by Miss M. Gosden M.B., B.Sc. Lond., M.R.C.S. Eng., L.R.C.P. Lond., the Government bacteriologist, who kindly cut and examined the sections :

Fowl No. 7, *Section* 8714.—*Brain*—all vessels very full of blood. No extravasation of corpuscles into secondary tissue. One vessel in the cortex shows a slight infiltration with round cells in its periphery. No infiltration seen round other vessels or in the brain tissue. *Spleen*—normal ; no masses of lymphocytes seen. *Bone marrow* (femur)—reticulated red marrow ; blood spaces filled with red corpuscles. *Liver*—all vessels very full of blood ; no extravasation ; no infiltration with lymphocytes.

Fowl No. 6, *Section* 8381.—*Red bone marrow, femur, and tibia*—sections show red bone-marrow, masses of myelogenous cells, mostly with coarse eosinophilic granules, and red blood corpuscles. No nodules of lymphocytes found.

Fowl No. 5, *Section* 8902.—Gelatinous exudate on upper surface of sacral cord. Microscopically consisting of faintly staining fibrils with lymphocytes scattered through it.

Fowl No. 4, *Section* 7427.—*Brain*—cortex and medulla : vessels crowded with red corpuscles as (8714) ; no extravasation and no infiltration with cells seen. *Sacral cord*—gelatinous exudate on anterior surface similar to 8,902.

Fowl No. 2, *Section* 6880.—*Brain cortex and cerebellum*—no infiltration with cells. The sections do not show the congestion seen in 8714 and 7427.

Healthy hen No. 1 (killed by chloroform). *Healthy hen No.* 2 (bled to death). Sections from the brains of both these birds do not show the congestion seen in 8714 and 7427, and there is no sign of infiltration round the vessels.

From the above post-mortem and histological notes it will be observed that in this particular outbreak the usual lesions which are now regarded as diagnostic of fowl paralysis were practically absent. There was generally a congestion of the nervous tissue examined, but in only one instance was a slight infiltration of round cells observed. In regard to the infiltration of round cells, which is considered an important point in diagnosis, Warrack and Dalling[5] state in a recent article : " In the brain cortex numbers of such cells may be comparatively few. Some difficulty in diagnosis may be experienced in the absence of typical ' cuffing.'

In cases of doubt, however, it is usually a fairly easy matter to procure suitable material from other affected birds in the flock."

Treatment.—Feeding Experiments.

Experiment 1.—The ætiology of the disease is obscure, but several workers have successfully transmitted the disease under laboratory conditions. One of the theories which has been advanced is that the disease is due to a deficiency of vitamin B. The feeding experiments we attempted were suggested by those carried out by Bayon (1931), who obtained varying, but in some cases promising, results. McCulloch is stated by Bayon and Hall to have obtained good results by feeding on fresh lettuce. It should be noted that prior to the outbreak of this disease in this flock the birds were receiving a fairly good mixed ration, including a certain amount of fresh green lucerne. Ten infected birds were obtained from the stud farm. They were divided into two pens of five. One pen received no additional yeast or green food, while the other pen received a daily addition of cabbage and bakers' yeast to the diet. After fifteen days it was possible to supplement the cabbage and yeast with an occasional feed of fresh green lettuce. It was only after the forty-sixth day that a continuous supply of lettuce became available. The addition of cabbage and yeast was then discontinued, and lettuce substituted for ten successive days. The following tables give the condition of the two pens at the beginning and at the completion of the experiment.

Untreated.—Group A. Condition at Commencement.	Result.
(*a*) Slight inco-ordination and weakness of the legs.	Died forty-sixth day, fowl paralysis complicated with fowl-pox four days prior to death.
(*b*) Slight lameness and weakness of the legs.	Died nineteenth day, fowl paralysis.
(*c*) Very slight weakness of the legs.	Apparently recovered.
(*d*) Very slight lameness.	Slight inco-ordination.
(*e*) Very lame ; both feet turning inwards.	Died forty-first day, fowl paralysis.

Treated.—Group B. Condition at Commencement.	Result.
(*a*) Very ill ; right leg extending backwards and not touching the ground. Rests continuously on sternum.	Died second day, fowl paralysis.
(*b*) Slight inco-ordination.	Apparently recovered.
(*c*) Signs of weakness ; frequent resting on metatarsi.	Apparently recovered.
(*d*) Signs of weakness ; frequent resting on metatarsi ; feet inclined to turn inwards.	Apparently recovered.
(*e*) Frequent resting on metatarsi and sternum.	Slight inco-ordination.

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At the commencement of the experiment the symptoms shown generally by Group A were not so marked as those of Group B.

Experiment 2.—Two other infected birds were submitted to a similar experiment. Bird No. 1 showed advanced signs of leg weakness, and practically continuous resting on the sternum and tarsi. When disturbed she walked with a staggering gait. There was some conjunctivitis present. She attempted to eat, but seemed to have some difficulty in swallowing. When she first came under our observation the crop was full. She was forcibly fed with lettuce for seven successive days.

Bird No. 2, which was used as a control, exhibited similar symptoms to the above, but they were not quite so marked when the experiment commenced. In four days No. 2 died from fowl paralysis. At the end of the seven days of lettuce feeding the condition of bird No. 1 was only slightly improved, the symptoms of the disease being still very marked.

Admittedly a very small number of birds was used in the above two experiments, but the results would appear to indicate that while an addition of lettuce will not cure advanced cases of the disease, it does seem to improve the chances of recovery in some cases, and would probably reduce the mortality in an outbreak.

Artificial Transmission.—The brain and spinal cord of a bird just dead from the disease were removed, and placed in glycerine for forty-eight hours. An emulsion was then made with saline, and three indigenous birds were inoculated with 0.4 c.c. intra-cranially. The three birds died between three weeks and a month subsequently without showing any signs of fowl paralysis. Two young indigenous cockerels were inoculated intramuscularly each with 1 c.c. of an emulsion of the spinal cord removed from a bird just dead of the disease. No symptoms of fowl paralysis developed, but both birds died in just under two months after inoculation.

Natural Transmission.—Two indigenous pullets were placed in close contact with five infected birds. One died in twenty-one days from other causes. The other bird remained healthy after being in contact for over two months.

Summary.—A small outbreak of fowl paralysis is described in which the cause was not determined. A parasitic cause could be excluded. The clinical picture closely resembled specific fowl paralysis, but on post-mortem there was a notable absence of macroscopic and microscopic lesions. The addition of lettuce to the diet of sick birds appeared to improve their chances of recovery. A few transmission experiments failed.

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INFECTIOUS ENTERO-TOXÆMIA, "PULPY KIDNEY," AND OTHER RELATED DISEASES OF SHEEP.

By H. W. BENNETTS, D.V.Sc.

Veterinary Research Officer, Council for Scientific and Industrial Research, Perth, Western Australia.

(1) Introduction.

THE possibility of certain diseases of animals being due to the absorption of bacterial toxins produced by the growth of specific organisms within the contents of the intestine, without actual tissue invasion, has only recently been recognised.

The writer, so far as he is aware, was the first to definitely demonstrate the ætiological significance of this type of toxæmia in the course of the investigation of a disease affecting sheep in Western Australia, formerly known as braxy-like disease, but to which the specific name "infectious entero-toxæmia" has now been given. The complete account of the disease is now in the press, and is appearing as Bulletin No. 57 of the Australian C.S.I.R. Meanwhile it seems advisable to give an abbreviated description of the condition, and draw attention to its possible relationship to other diseases of sheep, notably "pulpy kidney," which would appear to be allied, if not identical.

(2) Infectious Entero-Toxæmia.

Infectious entero-toxæmia is an acute toxæmia of sheep following the rapid multiplication of a specific toxicogenic anaerobic bacterium, *B. ovitoxicus* n. sp., within the contents of the small intestine. The disease has a seasonal occurrence, May to October, corresponding with period when green feed is available. There is a definite association with cultivation (depasturage on crops, oats, rape, etc.) and pasture improvement. The incidence varies very considerably from year to year according to seasonal factors influencing growth of feed, and the development of a naturally acquired immunity in flocks where the disease has been present for some years.

An outstanding feature is that sheep in the most forward condition are specially susceptible, rapidly fattening animals particularly so. Under certain conditions, *viz.*, when sheep are feeding close to the ground on paddocks previously heavily contaminated from carcases of sheep dead of the disease, those in poor condition may succumb, presumably on account of massive infection with *B. ovitoxicus* picked up with soil. Sheep of all ages, from lambs two months old onwards, may be affected, although young animals more frequently develop the disease. Breed and sex are of no particular significance. The mortality rate varies from less than 1 per cent. to 30 per cent. of the flock.

Infectious entero-toxæmia was first reported in this State in 1915, and was first investigated and described by Dakin[5] in 1918. It was then known as

Beverley disease, or braxy-like disease, and the cause was undetermined. There is evidence that the disease is not confined to this State. Bull[4] described a condition in South Australia which is almost certainly identical. Seddon has recently encountered a disease in New South Wales which is apparently entero-toxæmia, and there are indications that its geographical distribution is still wider. In 1902, and subsequently,[13] and again in 1910,[14] Gilruth described a somewhat similar braxy type of disease in the South Island of New Zealand affecting hoggets fattened on turnips, and recently expressed the opinion that it is probably the the same as that occurring in this State. As far as Western Australia is concerned, the disease is widespread in the southern portion of the State, and is of considerable economic importance.

(i) *Clinical Description.*—The period between the onset of recognisable symptoms and death is very short. Almost invariably sheep are merely found dead, usually near the camp in the morning. Occasionally symptoms are shown after driving, as in changing pasture, yarding, etc., and dead sheep are very often found on the morning following a change over to fresh pasture. As a result of careful supervision of flocks, thirty sheep have been seen in various stages of the disease. Two types of syndrome have been noted :—

(*a*) *Comatose Type.*—Commonly there is an initial stage characterised by a staggering gait and " knuckling over " of fore limbs. The sheep moves about with nose to the ground, chewing dirt, sticks, etc. Decubitis follows, the subject usually lying on its side with head turned round to the left flank. Coma supervenes, and respirations are accelerated (up to 180 per minute) and irregular. Temperature is not generally elevated. Death occurs quickly, usually within three to four hours of the first signs of illness, but in rare cases it may be delayed for about twenty-four hours.

(*b*) *Convulsive Type.*—An animal, apparently only slightly dull, is suddenly seized with convulsions. It lies stretched out on its side and exhibits, almost up to the point of death, more or less violent galloping movements associated with twitching of muscles, rolling of eyes, grinding of teeth, excessive salivation, and later pronounced opisthotonos. Death occurs usually within two to four hours. The convulsive syndrome is less commonly seen in older animals, but is frequently exhibited by lambs. (It is suggested that toxin of *B. ovitoxicus*, like that of the related organism *B. welchii*, is complex ; and that differences in pathogenic effects, as described, are due to differences in concentration of neurotoxin, etc.)

(ii) *Pathology.*—The pathological features indicated are based on the examination of thirty typical cases found while sick, and either killed when symptoms definitely indicated the nature of the disease, or allowed to die. The autopsy was made immediately after death in every instance. In addition, many animals have been examined at various periods subsequent to death. There is nothing pathognomonic of the disease, the lesions being essentially those of toxæmia. The most typical features are injection of mesentery, patchy congestion of the

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rather empty small intestines, congestion of the kidney, and sub-endocardial hæmorrhages, particularly in the left ventricle. The large intestines may also be congested; mesenteric lymph glands are frequently enlarged and œdematous.

Microscopically, the liver shows acute toxic changes, the parenchymatous cells being granular and cloudy. Frequently some fatty changes are present, and often capillary congestion. The small intestines (and to a less extent abomasum and large intestine), if preserved within a short time of death, show no changes other than a varying degree of congestion of the mucosa, less often of the sub-mucosa. The tips of villi are frequently hæmorrhagic. Extensive desquamation of the m.m. was observed in one case only. In suitably stained sections of the small intestine large numbers of *B. ovitoxicus* are observed on the surface of the m.m., but there is no invasion of the bowel tissue. The kidneys show hyperæmia, particularly in the boundary zone and medulla. The epithelial cells of the tubules may show slight toxic changes.

In the case of carcases found dead of the disease, " pulpy kidney " is invariably found even within an hour or so of death. The histological changes are then identical with those described by Stewart[23] for " pulpy kidney " disease. These field observations have also been confirmed experimentally: in a fat lamb artificially affected with entero-toxæmia, and which was left unopened for three hours after death, identical " pulpy kidney " changes were observed; whereas in the case of fat lambs killed by stunning, and left for the same period before opening, under the same weather conditions, the kidneys were found to be comparatively normal macroscopically and microscopically.

(iii) *Ætiology.*—The investigation of the cause of the disease was commenced in 1925. In 1926 the opinion was expressed[2] that the condition was probably due to the absorption of bacterial toxins from the intestinal tract. As a result of further investigations in 1928, this theory received some confirmation, Seitz filtrates of small intestine contents of affected sheep being shown to be toxic for laboratory animals and sheep. The toxin was shown to be of bacterial origin, and resulted from the growth in the bowel contents of an organism of the *B. welchii* type. The disease was then described as a *B. welchii* toxæmia.[3] Later work showed that the causal organism can be differentiated from the closely allied organisms *B. welchii*, the lamb dysentery bacillus, and *B. paludis*, by cross immunity reactions. It has been named *B. ovitoxicus*, and a complete account of the anaerobe and its relationship to the above-mentioned organisms is being published elsewhere. The ætiological significance of the organism has now been definitely established on the following grounds:

(*a*) *B. ovitoxicus multiplication in the small intestinal contents.*—The active multiplication of *B. ovitoxicus* (up to 500 million per c.c.) in the small bowel contents is a constant feature of the disease (eighteen cases killed for examination), and it was the only anaerobic spore-bearing organism which could be isolated

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therefrom in seventeen out of the eighteen subjects. The presence of the organism in the small bowel contents of healthy sheep from "clean" and "affected" properties, or of sheep dying from other diseases, has not been demonstrable by identical microscopic and cultural methods.

(*b*) *Toxin Production of B. ovitoxicus in Small Intestine Contents.*—Sterile Seitz filtrates of small bowel contents from fourteen out of sixteen sheep affected with entero-toxæmia have been shown to be highly toxic for laboratory animals. (Amounts of 0.005–0.002 c.c. have been fatal to mice on intravenous inoculation; 0.02 c.c. or less on intramuscular inoculation. The lowest amount proved toxic for guinea-pigs on intra-muscular inoculation was 0.45 c.c.). The pathogenic action of these filtrates has been identical with that of *B. ovitoxicus* toxin. They are neutralised by *B. ovitoxicus* antiserum and by lamb dysentery antiserum (the action is not reversible in the latter case), but not by *B. welchii* (several sources), or *B. paludis* antisera. Similar filtrates from normal sheep or from sheep dying of other diseases are non-toxic for laboratory animals when inoculated in comparatively large amounts. Filtrates from normal sheep are non-toxic for sheep.

(*c*) *Experimental Reproduction of the Disease with B. ovitoxicus.*—By drenching sheep under certain circumstances (bowel sluggishness induced by therapeutic doses of opium and belladonna) with small amounts (50–200 c.c.) of cultures of *B. ovitoxicus*, originally isolated from small bowel contents of affected sheep, one can reproduce a disease identical with the naturally occurring disease in all particulars—clinical, pathological and bacteriological. *B. ovitoxicus* may be re-isolated from the small intestine contents of an experimental animal, and will again reproduce the disease *per os*. The disease has been successfully reproduced in six experimental subjects, and confirmatory results were obtained in Melbourne, where entero-toxæmia is not known to exist. Experimental sheep inoculated with bowel or culture toxin develop a disease which resembles entero-toxæmia in all respects, except that there is a local response to the toxin inoculated.

(*d*) *Absorption of Toxin from the Small Intestine.*—The absorption of *B. ovitoxicus* toxin from the small bowel contents has not been proved directly, but there is very strong evidence that such does occur. The clinical and pathological identity of entero-toxæmia with experimental *B. ovitoxicus* toxæmia of sheep indicates this. The toxins or other products resulting from the growth of the organism produce an inflammatory reaction in the m.m. of the small bowel, and the work of Magee and Southgate[18] indicates that absorption would be assisted by this devitalisation of the lining of the bowel.

(*e*) *Immunity Conferred by B. ovitoxicus Anaculture.*—Available evidence indicates that sheep may be actively immunised against the disease. In 1930 the mortality rate in a flock of sheep was reduced from 4.6 per cent. (932 sheep as controls) to 0.2 per cent. (932 sheep inoculated), by the use of *B. ovitoxicus*

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anaculture. During the current season further inoculations (10,000) have been carried out, and results so far obtained are confirmatory.

(*iv*) *Pathogenesis.*—As a result of field observations and experimental work, it is suggested that the train of circumstances leading up to affection with enterotoxæmia is as follows: *B. ovitoxicus* is probably introduced to a property by animals carrying it as a normal bowel inhabitant. Cultivation and soil improvement provide conditions which are ideal for its growth in the soil, and possibly also for its increased virulence. Improvement of pasture increases the carrying capacity of the land, and is thus productive of heavier soil contamination. The sheep themselves respond to the improvement in pastures by fattening more rapidly, consequently becoming more susceptible. When fat sheep are feeding on abundance of feed low in fibre content, and taking practically no exercise, it appears that a temporary sluggishness of the bowel may result; the ingestion of wet luscious green feed early in the morning may also be a factor. The small bowel is seeded with *B. ovitoxicus*, probably from the anterior end by spores ingested, or possibly with spores from the large bowel, and under conditions of temporary partial bowel stasis.

B. ovitoxicus is able to grow and produce a potent exotoxin in the contents of the small intestine which appear to be ideal for the purpose. The opinion is held that under normal conditions the initial sterilising action of the acid secretion of the abomasum and the more or less rapid passage of the ingesta through the small bowel prevent the proliferation of *B. ovitoxicus* as well as other organisms in the contents. Less frequently the important predisposing factor may be the continuous ingestion of large numbers of *B. ovitoxicus* when sheep are feeding close to the ground on soils which are heavily contaminated by this organism. Comparatively rarely trauma of the small bowel caused by ingestion of fruiting *Inula graveolens* may be the factor which provides conditions suitable for the proliferation of *B. ovitoxicus*. Symptoms and death result from the absorption of toxin from the bowel. In the comatose type of the disease it appears that heart failure is the cause of death, whereas in the convulsive type death would appear to be due to the action of a neurotoxin. The disease is a toxæmia quite independent of any tissue invasion by *B. ovitoxicus*, although a few bacteria may be found in blood and tissues at the point of death, as demonstrated by cultural methods in two out of ten cases.

(*v*) *Methods of Control.*—Prophylactic inoculation with anaculture would appear to be the most promising line of attack. The preventive effect of "bush country" has been effectively demonstrated. In our opinion the results noted are in part due to the high fibre content of the scrub feed. The feeding of roughage (hay, straw, etc.) appears to be indicated. Exercise has been noted to have a beneficial effect on the incidence of the disease. Close grazing of heavily contaminated paddocks is to be avoided, and the acquisition of naturally acquired immunity should be fostered by breeding as far as possible from flocks already on the property. The proper disposal of carcases is, of course, also to be recommended.

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(3) " Struck "-Enteritis and Peritonitis and Peritonitis of Sheep caused by a Bacterial Toxin derived from the Alimentary Canal.

Under the above title, McEwen and Roberts[19] have recently described a disease occurring in Kent which appears also to be a toxæmia resulting from the absorption of a bacterial toxin from the alimentary tract. Although the claims put foward with regard to the ætiology of the disease are most probably correct, we are of the opinion that further confirmation is needed. Only a small number of subjects have been examined at the point of death (before post-mortem changes occurred); only three such cases are recorded as having been examined bacteriologically; and, finally, *B. paludis* toxin has only been definitely detected in filtrates from the small bowel contents of one case and from the abomosal contents of one further case. Indefinite or negative results were obtained with filtrates from the three further cases recorded. The disease as described by McEwen and Roberts differs essentially from entero-toxæmia in that extensive transudations of fluid are found in the peritoneal cavity. These are entirely absent in the Western Australian disease, although rarely observed in sheep which have been dead presumably of entero-toxæmia for some hours. Ulceration of the small intestine is stated to be a frequent lesion in " struck "; it has only once been observed in entero-toxæmia. Finally, owing to the courtesy of McEwen in providing the writer with a strain of *B. paludis*, and some corresponding antiserum, we have been able to show that *B. ovitoxicus*, though closely resembling *B. paludis* in many respects, is a distinct anaerobe. Muscular lesions, described as a post-mortem change in cases of " struck," have not been observed in sheep dead of entero-toxæmia. Apart from these essential differences, there are striking resemblances between the Western Australian disease and the disease described by McEwen and Roberts.

(4) Lamb Dysentery.

Lamb dysentery, as described by Gaiger and Dalling[7, 8], and Pool[22], comes under a different category, in that there is a definite necrosis and bacterial invasion of the bowel wall, although Dalling[6] states that the causal organism, the lamb dysentery bacillus, can be isolated from the bowel contents of lambs dying of " milk ill," in which there is no ulceration of the bowel. It is conceivable that more than one type of disease has been described under the same name of " lamb dysentery." The presence of lamb dysentery toxin in the bowel contents apparently has not been investigated.

(5) " Pulpy Kidney " Disease.

(1) *The Disease in New Zealand.*—This disease of lambs was first investigated by Gilruth, who concluded that the trouble was of dietetic origin. Gill[9], in 1927, investigated the condition in Central Otago, and associated the recent increased incidence of the disease with improved carrying capacity of the land, and with the increase in the use of Romneys, which breed is stated to fatten extremely well in that district. The general account of the disease given might almost

equally be applied to entero-toxæmia, with the following exceptions: the age incidence of " pulpy kidney " disease is stated to be two and a-half to four weeks old (rarely older lambs affected), the kidneys in fresh cases of the disease are described as being enormously congested with blood, whereas in entero-toxæmia the degree of congestion is only moderate. Gill recognises " pulpy kidney " as a post-mortem change, and his description is equally applicable to kidneys from a sheep or lamb dead of entero-toxæmia. In a further account of the disease, Gill[10] notes the detrimental effect of close feeding on pastures where heavy losses had previously been experienced. The beneficial effects of exercise and periodical yarding were demonstrated (again compare entero-toxæmia). Later, in 1928, Gill[11] propounded a new theory of ætiology, suggesting that in over-fat lambs " certain bacteria, normally present in the large intestine, might be responsible for setting up the toxic condition which caused death." Subsequent references by Gill[12] and Hopkirk[16, 17] would indicate that some evidence has been obtained in confirmation of this theory. An organism of the *B. welchii* group would appear to be suspected.

(2) *The Disease in England.*—Stewart (*loc. cit.*) gives some account of a disease which appears to be identical with that described in New Zealand. He gives the age incidence, however, as from twelve to fifteen weeks, and the disease is said to occur amongst lambs fattened on concentrates. He investigated the possible relationship of high protein diets to "pulpy kidney " disease, and concludes that they cannot be held responsible for this condition.

McKenna[20] notes a similar disease affecting lambs eight to ten weeks old, and remarks that the disease is prevented by the withdrawal of concentrates.

Montgomerie and Rowlands[21] give an account of " pulpy kidney " disease in North Wales, which account is almost equally applicable to entero-toxæmia: the history, clinical signs and lesions are practically identical, although the age incidence is different (three to six weeks). They regard their condition as being identical with that described by Gill, but point out that it differs from the condition described by Stewart and McKenna in that it is confined to younger lambs and lambs not receiving concentrates. They have investigated the toxicity of Seitz filtrates of small bowel contents of eleven cases of " pulpy kidney," dead for various periods prior to examination. These filtrates were found to be toxic for laboratory animals, although the toxic material contained in bowel filtrates was thermolabile (suggesting a bacterial toxin). *Anti-vibrion septique*, anti-lamb dysentery and anti-*œdematiens* sera failed to neutralise the toxicity of these filtrates. The writers tentatively consider the " toxin " as a product of protein disintegration. It has been more recently stated[24] that the use of lamb dysentery serum in flocks affected with pulpy kidney disease appeared to prevent losses from that disease. It is also suggested that the disease may be an acute intoxication due to organisms of the *B. welchii* group.

(3) *Similar Diseases in U.S.A.*—Under the name " diabetic coma of feed-lot sheep," Baker, Reid and Owen[1] have described a disease which again would

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appear to be closely allied to entero-toxæmia. The symptoms as described are very suggestive, as is the absence of any definite lesions. Sheep in rapidly fattening condition are affected, and a reduction in the amount of carbohydrate in the diet is of prophylactic value. The blood and urine of affected sheep have been shown to be high in sugar.

Hadley and Strange[15] describe a somewhat similar complaint as " digestive disorders in lambs caused by overfeeding." The disease is ascribed to overfeeding and lack of exercise, and a more bulky ration is recommended as a preventive measure.

(6) The Possible Relationship of Entero-Toxæmia of Sheep in Western Australia to " Pulpy Kidney " Disease.

The writer advances the opinion that the " pulpy kidney " diseases described in England and New Zealand are closely allied to, or are merely phases of, entero-toxæmia. It may be criticised that it is well to be wise after the event, but as a matter of fact we had held this opinion for some years, and had suggested it some time ago in an unpublished report. Following the completion of the investigation of the ætiology of entero-toxæmia, and the recent trend of opinion to ascribe " pulpy kidney " and other similar conditions to a possible bacterial toxæmia of bowel origin, the writer feels justified in publishing his view. It would appear that some organism belonging to the *B. welchii* group (*B. welchii*, the lamb dysentery bacillus, *B. paludis*, or some hitherto undescribed species) is most likely to be operating, possibly a different organism in various regions affected. The apparent differences in the diseases reviewed under the section " pulpy kidney " disease are probably accidentals rather than essentials. The chief disagreement is with regard to age incidence. The dissimilarity here is probably due to variation in diet and handling of lambs and sheep in different localities. The appearances of the diseases correspond with rapid fattening and lack of exercise, and is probably influenced by many factors, seasonal and other, and possibly also by regional differences in the biological activities of organisms of the *B. welchii* group. It appears to the writer that the investigation of this type of disease, along similar lines to that pursued with entero-toxæmia, is well worth while.

Conclusions.

(i) A brief account is given of infectious entero-toxæmia, a disease affecting sheep in Western Australia. (ii) Infectious entero-toxæmia is an acute toxæmia of sheep following the rapid multiplication of a specific toxicogenic anaerobic bacterium, *B. ovitoxicus* n. sp., within the contents of the small intestine. (iii) Published accounts of " pulpy kidney " disease in New Zealand and England are reviewed, along with two accounts of somewhat similar diseases in U.S.A. (iv) The opinion is advanced that " pulpy kidney " disease is closely related to, or possibly merely a phase of, entero-toxæmia. It is suggested that the investigation of this disease or group of diseases along similar lines to that undertaken with entero-toxæmia may lead to the incrimination of organisms of the *B. welchii* group as ætiological factors.

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A NOTE ON AN OVINE AFFECTION.

By W. J. LEYSHON, M.R.C.V.S.
Veterinary Inspector, London County Council.

On May 18th, 1929, 277 Scotch hoggs (Lot "A") arrived in one of the London public parks for summer grazing, and on the 12th of the following month 216 Wensleydale tegs (Lot "B") were mixed with Lot "A." On June 18th one died of Lot "A," and on the 29th of the same month the first death occurred in Lot "B." The number of sheep dying was highest in July, but deaths ceased about the 17th of the following month, when the total mortality had reached 7.09 per cent.

Segregation of the affected animals was tried at the eighth death on June 24th, but this soon proved ineffective owing to the daily appearance of cases in the remainder. It rapidly became uncertain to say which animals appeared free from the disease, as the majority of the flock seemed affected in varying degrees. Although the death-rate was low, considering the number of animals affected, yet the survivors had been so severely attacked by the disease, that when they

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left the park on October 15th, most of them were unsaleable to the butcher. On arrival, Lot " B " was the better consignment, whilst Lot " A," although apparently normal on June 1st, was in poorer bodily condition than this class of " store " usually is. In neither batch, however, were there present marked symptoms suggestive of the animals being grossly infested by helminthes. Lot " A " was dipped on June 6th. Contact was somewhat intimate when grazing by day, but was more so during night penning. Ranges were not varied each day. Reappearance of the disease has not been encountered in flocks on the same pasture during the two succeeding seasons.

Symptoms.—In acute cases a change from that of normal could be noticed in about twelve hours. This was evinced by the sheep appearing depressed, ceasing to graze, breathing faster, and with the rise of about a degree in body temperature. Some cases died in about twelve hours from the onset of symptoms, others lived for three or four days. Loss of bodily condition was rapid, and some dyspnœa was present in the later stages. Diarrhœa was sometimes present immediately before death. Those not fatally infected lost considerable bodily condition during some four or five days, when appetite was almost in abeyance. They showed slight watery nasal discharge and coughed a little. Thereafter pasture was eaten in increasing quantities, but it was doubtful if complete recovery ever occurred.

Morbid Anatomy.—As autopsy was attempted only in cases of recent death, and where illness was known not to have lasted more than about three days, the number performed was only eight. On opening the thoracic cavity, a small quantity of clear straw-coloured fluid was usually present. The lung tissue presented consolidated areas which involved, almost invariably, the right apical lobe in its entirety. In addition, the mediastinal lobe was much hepatised, and also the inferior borders of the other lobes up to about four centimetres from their edges. The pleura did not appear to be considerably involved in the process, but in the hepatised lung greyish nodules of about one millimetre in diameter could be seen On opening up the trachea and larger bronchi there appeared an excess of mucus, which on being mixed with normal saline solution failed to reveal any *Dictyocaulus filaria.* It is interesting to note that no nodules resulting from infestation by *Synthetocaulus rufescens* were present. On section, the lungs exuded a sero-sanguinous fluid ; the consolidated areas were greyish-red in colour, and of the consistence of kidney. The bronchial and mediastinal lymphatic glands were slightly enlarged, and on section were congested. Some nematodes were found in the abomason, but usually no lesions of distomatosis.

Bacteriology.—As culture material was chosen only from those cases which died within the preceding five hours (one case within one hour), the number selected was five. In smears made from consolidated areas of lung, numbers of Gram-negative bacilli which retained the stain more deeply at their poles were observed. Cultures grown aerobically from pleural fluid, heart blood and bronchial lymph gland showed a pure growth of organisms morphologically identical with those observed in smears. Cultures from the lung showed an almost pure

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growth of the organism, but in one case there were also a few colonies of other organisms which were regarded as contamination.

When inoculated into " Lemco " plain broth, these organisms produced a turbidity after eighteen hours incubation at 37° C., but on standing, the growth settled to the bottom of the tube. Further incubation did not produce either pellicle formation or viscosity of the sediment. Material inoculated on inspissated ox serum and incubated for a like period gave rise to glistening, almost clear greyish colonies of about one millimetre in diameter. After a further twenty-four hours incubation these growths were doubled in size, were smooth, circular in outline, and tended to become greyish-brown in colour. Gelatin stab cultures kept for four days at 18° C. unfortunately liquefied owing to a rise in temperature of the cool incubator, but there did not appear evidence of growth in the medium.

Microscopical Appearance.—The organism isolated from pleural fluid, heart blood, thoracic lymph gland and lung was a small Gram-negative bacillus. In thionin-blue preparations the size measured $4\mu \times 0.7\mu$, but in safranin-stained specimens the organism appeared smaller. Smears from fresh material stained by an aqueous solution of safranin showed marked bipolar staining, but in cultures this appearance was not so evident. The organism stained with the common aniline dyes, but the most marked polar staining was observed in sections stained with thionin blue. In cultures the bacillus was non-motile. Attempts at chain formation were noted, while in older growths pleomorphic individuals could be found.

Biological Characters.—The organism grew easily on inspissated serum and in " Lemco " broth. No hæmolysis and no indol formation could be detected. Cultures tended to die out quickly, and when left on the bench at room temperature for forty-eight hours growth could not be transmitted to fresh culture media. On plating out the cultures the organisms were found to be present in pure culture. The bacillus fermented saccharose, maltose, mannite, glucose, lævulose, and galactose with the production of acid, but no gas. Dulcite and lactose were not fermented, and when grown in milk no change was observed.

Histology.—Portions of hepatised lung from which cultures had been made were fixed in 10 per cent. formol-saline. Sections passed through paraffin process showed not only catarrhal pneumonia with some bronchial change, but also evidence of red corpuscle destruction. Briefly, the pathological changes are as follows :—

Firstly, air vesicles are filled with what appears to be exuded lymph, an increased number of proliferated cells resembling endothelium, and some mononuclear cells. The capillaries and larger blood vessels are congested, and leucocytic migration is evident in the suffused interlobular septa. Cases of more prolonged illness show the alveoli packed with the catarrhal cells already mentioned, and in addition some polymorphonuclear leucocytes and degenerating erythrocytes. In older lesions degeneration of the nuclei occurs, and the cellular elements become indistinguishable. In the lumen of the bronchus there is seen desquamated ciliary epithelium, and some cells of endothelial type. The bronchioles are densely filled with cell debris. Sections through the macroscopic greyish nodules

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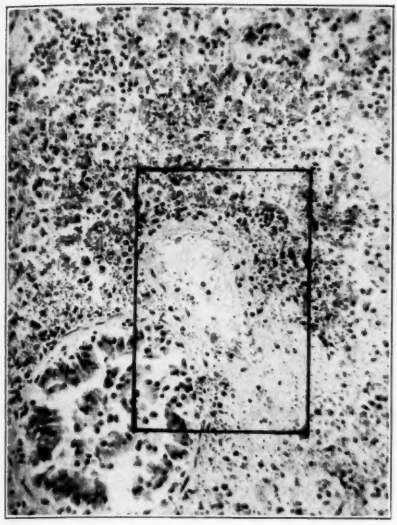

PLATE I. (× 140).

Section of lung stained hæmatoxylin-eosin, showing consolidation due to exudation of fibrin and red corpuscles and the presence of numerous mononuclear cells. In the centre is a small area of necrosis. The small bronchiole shows proliferation and desquamation of the epithelium.

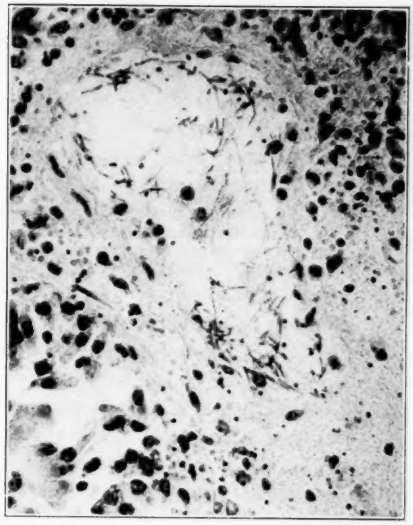

PLATE II. (× 385).

This shows a higher magnification of the area marked in Plate I. Note the blood destruction and scattered blood pigment and the fairly extensive hæmorrhage. The filaments in the necrotic area are composed of chains of bipolar organisms.

PLATE III. (× 900).

Section stained by carbol thionin blue. Lumen of blood vessel containing very numerous bi-polar organisms.

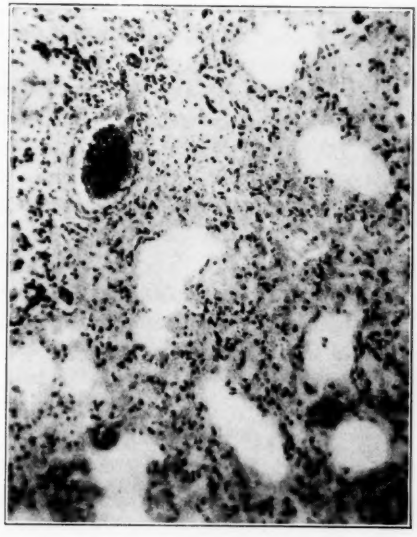

PLATE IV. (× 110).

This section stained by hæmatoxylin-eosin, shows early pathological change, namely, œdema, congestion, hæmorrhage and commencing consolidation.

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before referred to proved them to be areas of necrosis. Apart from congested vessels, sections of lymphatic gland showed nothing pathological.

Discussion.—Infectivity is suggested as disease, did not appear simultaneously in both lots. Lot "A" possibly contained "carriers." The amount of lung tissue rendered functionless does not seem physiologically to have accounted for the deaths. Owing, however, to the almost ubiquitous distribution of the vast group of Pasteurella organisms, ætiological significance attributed to any one of its members requires conclusive proof.

Hutyra and Marek[1] mention they occur not infrequently in the air passages, to become pathogenic either under unknown conditions or when favoured by such weakened resistence of the host as that caused by cold, exertion, anæmia, parasites in the air passages, etc. The organisms having attained increased virulence, contacts of the same species of animal succumb to infection without a predisposing cause. In the absence of data as to the pathogenicity of this bacillus for experimental animals, the organism seems to have been concerned in producing lesions. Post-mortem or even ante-mortem invasion might have accounted for the bipolar organisms being present in the blood stream and the thoracic lymph glands. If a filter-passing ætiological agent is excluded, there exists the possibility that the bipolar bacillus was responsible for producing the diseased condition by reason of its persistence in a short series of comparatively "fresh" subjects, and its presence in large numbers and apparently pure culture.

Literature affords plentiful accounts of Pasteurella organisms isolated from ovine pneumonia, but many such records refer to disease in other countries, which condition is more virulent in type and displays also enteric lesions. The Pasteurella isolated are markedly pathogenic experimentally, conform to the characteristics of the so-called hæmorrhagic septicæmia group, and vary considerably in cultural characteristics from those of the organism now in question.

Dungal[2] records a contagious pneumonia of sheep which occurs in Iceland between the months chiefly of October and June. He found the principal changes to occur in the lungs, from which he isolated a Pasteurella organism pathogenic to sheep. His subjects were older generally than the London sheep, but there exists so close a resemblance between the two conditions that this incomplete account may be of interest as comparison.

Summary.—An outline is given of a condition found in London grazing sheep, characterised generally by a progressive emaciation, but sometimes by sudden death. Lesions were confined to the thorax, and a description is recorded of a bipolar organism isolated. It would appear that this organism, probably by enhanced virulence, was capable of attacking normal tissue.

Acknowledgment.—The writer is indebted to J. E. McCartney, Esq., M.D., D.Sc., for his kindness both in preparing sections and photomicrographs.

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THE TOXICITY OF SORGHUM HALEPENSE (JOHNSON GRASS) FOR SHEEP.

By F. H. MANLEY, B.V.Sc., M.R.C.V.S.
Department of Agriculture, Cyprus.

Sorghum halepense grows wild in most parts of Cyprus, both on the plains and in the mountainous areas, particularly in irrigated fields and gardens. It is known by some shepherds that the plant when young is poisonous to stock, but that in the older fruit-bearing stage it becomes non-poisonous.

In 1928, the Chief Veterinary Officer, Mr. R. J. Roe, observed a case of poisoning in a heifer. Two hours after the animal had been grazing in a garden in which this plant was common, alarming symptoms developed, the animal going down, and the limbs being extended stiffly. The animal, however, recovered in a few hours from the acute symptoms. In two days she had almost completely recovered, although she then exhibited a papular eruption in the region of the shoulder and neck on the near side.

In September, 1931, two goats were reported to have died from eating this plant. It was further reported that the loss of two or three goats from this cause was an annual occurrence in this particular flock. The local name for the plant is " Kalamangra." The identity of kalamangra with *Sorghum halepense* has been confirmed by the authorities at the Royal Botanical Gardens, Kew. Hill[1] states : " the plant is a native of the Mediterranean region, and was introduced into some parts of the world as a fodder grass, but is now mostly regarded as a pestilential weed on account of its rhizomes. It is frequently reported as poisonous to stock, especially in the young stage, as the leaves then contain a prussic acid yielding glucoside." Leppan and Boseman[2] say that Sorghums checked in growth during dry bright weather develop poison to a dangerous degree, and when frosted, the aftermath is said to be particularly dangerous. They state further that no cases have been found of prussic acid poisoning of stock fed on sorghum silage, and that if fed when cut and wilted, the toxin largely disappears.

The Imperial Bureau of Animal Health has kindly supplied us with other references and extracts of articles relating to sorghum poisoning in animals, some of which are quoted below. It would appear from these that there have been few definite cases recorded of poisoning in sheep due to *Sorghum halepense.*

According to Hansen (1928)[3] a cyanogenetic glucose occurs in Sudan and Johnson grass, principally in the young plants, and when the foliage is wilted or stunted by frost, injury or drought. Normal mature plants are believed to be practically harmless. Symptoms of Johnson grass poisoning are unsteadiness, twitching of head muscles, myopia, salivation, convulsions, paralysis, and death. Prussic acid sometimes causes involuntary micturition.

Cornevin[4] writes about *Sorghum saccharatum,* relating cases of poisoning in sheep and cattle fed with cut, old-standing sorghum : Two kg. were given per

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day, and three cattle refused to touch it, but the rest (twelve) ate it, and two died with symptoms of tremors, somnolence, unsteadiness behind, protruding eyes, anorexia, enlarged abdomen and frequent urination.

Mettam[5] (1928) says: "It is generally stated in text-books of toxicology that only three grasses are known to be poisonous, *e.g.*, *Setaria sulcata*, *Sorghum Sudanese* (Sudan grass), and darnel (*Lelium temulentum*). In *Setaria sulcata* and darnel the seeds only are poisonous, the former, as far as is known at present, for birds, and the latter for man and all herbivorous animals.

"Recent work in America and Bechuanaland, South Africa, has show that many of the gramineæ may, under certain conditions, become markedly poisonous for herbivorous animals on account of the formation of excessive quantities of hydrocyanic acid. Swanson and Henrici have shown that sorghum and andropogon produce HCN on wilting. This acid causes grave symptoms and even death in cattle, and to a less extent in horses."

One of our stock inspectors has reported that he considered the plant was most poisonous when dug up during the process of weeding, and allowed to dry in the sun. Our experiments would appear to indicate that the dried young plant is extremely poisonous to sheep. At the beginning of our feeding experiments only grass in an advanced stage of growth was available.

Experiment 1. *The Seeding Plant.*—Three native sheep, Nos. 38, 9, and 13, were starved for twenty-four hours. *Sorghum halepense*, which was seeding, was then allowed *ad lib.* No other food was allowed for seven days, and a considerable amount of the grass was eaten. No symptoms of poisoning developed, and the sheep reverted to normal diet.

Experiment 2. *The Dried Young Plant.*—A quantity of the young plant, which was about eight inches high, was now obtained. There was a moderate amount of the young roots present. This sample as allowed to dry for about forty hours before being fed to the sheep. Two sheep, Nos. 38 and 9, were starved for twenty-four hours, and then approximately two pounds of the young partly-dried plant was placed in front of them. They commenced eating with avidity, but after consuming about half a pound in all they ceased feeding.

Symptoms Developed by Sheep No. 38.—A half-hour after commencing to feed she appeared dull and depressed. In one hour she was down. On being raised to her feet she made a few spasmodic movements of the limbs, staggered, and fell. The respirations were laboured and deep. The mucous membrane of the eye was congested. Urine was passed frequently. She died two and three-quarter hours subsequent to commencing to feed.

Post-mortem.—The blood was intensely red in colour, and showed some lack of coagulability. The lungs, spleen and kidneys were congested, but the liver showed the paleness associated with fatty change. The four stomachs contained a fair quantity of food, and the small quantity of "Kalamangra" was found in the rumen and reticulum. There was a distinct smell of bitter almonds in the chest cavity. The other organs were normal.

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Symptoms Shown by Sheep No. 9.—The symptoms were not so severe as those of No. 38. In one hour she was dull, and stood with the head lowered. After four hours there were marked periodical muscular spasms, particularly of the shoulder and neck regions. The respirations were slightly laboured and deep, and there was some snoring. Later the animal went down, and when raised it stood motionless. It was apparently unable to walk. Urine had been passed several times. The animal was down and unable to get up for several hours, but eventually recovered.

Experiment 3. *No Preparatory Starvation.*—Sheep No. 32, which had undergone no preparatory period of starvation, was allowed to eat two ounces of the same plant as that used in Experiment 2. Symptoms of poisoning commenced in fifteen minutes. The animal was dull and disinclined to move. Very soon some muscular tremors of the hind limbs occurred, and the animal went down. In five minutes she got up and moved about the loose box with the head elevated. General muscular tremors then occurred. At this stage the breath smelled strongly of bitter almonds. The animal went down again, and was unable to stand. Urine was passed frequently. There was considerable salivation. Death occurred forty-five minutes after animal had eaten the plant. The post-mortem findings were similar to those of sheep No. 38.

Experiment 4. *The Fresh Young Green Plant.*—Only a small quantity of material was available. A ewe which had received no preparatory treatment received 14 drams. It was necessary to feed most of the amount forcibly. No symptoms of poisoning developed. Ewe No. 39 similarly received 24 drams. No symptoms developed.

The Same Specimen Dried.—Only a very small quantity remained. This was dried, and the following day fed to two sheep, one receiving two drams and the other seven drams. No symptoms developed in either case.

Experiment 5.—The fresh green plant, older than that used in Experiment 4, and some shoots commencing to seed. Three ewes received two, four and six ounces respectively of the fresh green material without developing any symptoms of poisoning.

Experiment 6.—Grass in the same stage of development as that used in Experiment 5 was dried for forty-eight hours. Two ounces were fed to a ewe without causing any symptoms to develop. We conclude that *Sorghum halepense* when dried in the early stages of its development is extremely poisonous for sheep. Insufficient material was available on this occasion to thoroughly determine the toxicity of the fresh young grass. In the later stages of its growth the plant appears to be definitely non-toxic.

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A NOTE ON DEATHS IN A STOCK OF ALBINO ANGORA RABBITS RECEIVING SUGAR-BEET TOPS IN THE RATION.

By W. KING WILSON,
Rabbit Department, National Institute of Poultry Husbandry,
AND
K. D. DOWNHAM, B.V.Sc., D.V.H.,
Veterinary Department, Harper Adams Agricultural College, Newport, Shropshire.

Introduction.

THE following paper reports the occurrence of deaths in a stock of albino rabbits used for wool production when the greenstuff of their ration consisted of sugar-beet tops wilted in varying degree. The fatalities started five to six weeks after sugar-beet top feeding was started and six to seven weeks after the lifting of the sugar-beet crop.

Material.

A stock of thirty White Angora (albino) rabbits was being used for wool production. These rabbits produced approximately 7–8 oz. of clippable wool per annum, or roughly 10 per cent. of their own body weight. Each individual was kept in a separate hutch measuring 3 ft. × 2 ft. × 1½ ft. high, and bedded on wheat straw. The rabbits were divided into groups of equal numbers: one group received a control ration of mash, oats, hay, and green food (or roots), the other group received a ration of hay and greens (or roots) only. The food was provided in two meals daily, and water was also given, although the hay and green ration group rarely drank. During the months of May to October inclusive, the greenstuff consisted of grasses, clovers and kale. On November 3rd the green food of the control ration group and half the green food of the hay and green ration group was replaced by sugar-beet tops, starting with small amounts which were gradually increased. The feeding of sugar-beet tops continued until December 14th. The average daily consumption of the different groups of foods is set out below:

TABLE I.

Average Daily Ration per Rabbit, 3.11.31–14.12.31.

Group.	Control Ration.	Hay and Green (or Root) Ration.
	ozs.	ozs.
Mash, dry	0.8 ...	—
Oats	0.7 ...	—
Sugar-Beet Tops	6.9 ...	12.1
Kale	— ...	13.9
Hay	1.2 ...	2.6

There was another group of adult rabbits comprising thirty Havanas (chocolate pigmented top fur, with blue-grey under colour to the hairs), which were fed similarly to the control ration group of albino Angoras. The average adult body

weight at the commencement of sugar-beet top feeding was in the region of four and three-quarter pounds for both breeds. Other rabbits of different varieties also received sugar-beet tops as their green food. The consumption of tops by the Angoras each week while given this foodstuff has been separated, and is shown in Table II :—

TABLE II.

Average Daily Consumption of Sugar-Beet Tops per Rabbit, in Weeks.

Week. 1931.	Control Ration. ozs.	Hay and green (or Root) Ration. ozs.
November 3–9	6.2	11.5
„ 10–16	6.6	12.0
„ 17–23	6.2	11.8
„ 24–30	6.4	10.3
December 1–7	8.0	13.5
„ 8–14	8.6	13.7

The Sugar-Beet Tops.—The beet crop was grown in a nearby field on a sandy loam soil. The crop was lifted about October 27th, when the tops were cut off and left lying on the soil, remaining there to wilt. On November 3rd (one week after topping) feeding of tops to the rabbits was started. At this time the leaves were green and fresh in appearance, and relatively clean, as the weather had been mainly fine since the crop was ploughed out, but after this the weather changed and became wet. In this field the College and N.I.A.B. Meteorological Station is situated, from the records of which the following weather notes are taken.

The weather was mainly cold, although frost was only recorded on three days during the feeding period. There was little sunshine, as rains, fog, or mist prevailed on many days ; 0.1 inch or more rainfall was recorded on fourteen of the forty-two days. On two days the readings showed 0.50 inch and 0.58 inch respectively. The tops were collected from the field as required for feeding. During December many of the outer leaves had reached an advanced stage of decomposition. The discoloured and visibly rotting leaves were removed from the crown before the good portion was fed to the rabbits. From December 12th onwards a flock of sheep was folded on the field.

Digestive Disorders.—Early in December several rabbits were noticed to be scouring, which coincided with the bulk of the leaves having to be discarded owing to their decayed condition. On December 8th, animal R466 showed symptoms of stomach pains : it showed distension of the abdomen, and was dead the following morning. Several rabbits in both the control and the hay and green food groups were failing in appetite, listless, and showing symptoms of stomach pains.

On the 10th, two animals were suffering acutely, unable to walk, and scarcely able to stand : their bellies rested on the pen floors, their eyes were lustreless, their heads hanging, and they presented a distressed appearance. Four deaths occurred on the 11th and 12th, followed by two further casualties on the 14th. There were no deaths in the Havana stock.

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TABLE III.

Dates at which Deaths Occurred.

Control Ration Group.			Hay and Green (or Root) Ration Group.		
Date. 1931.	Identity.	Days since S.B.T. Feeding Commenced.	Date. 1931.	Identity.	Days since S.B.T. Feeding Commenced.
December 9	R466	37	December 11	P179	39
„ 11	169	39	„ 11	592	39
„ 12	R595	40	„ 14	591	42
„ 14	R98	42			
„ 14	27	42			

Post-mortem examinations were carried out, and the following conditions were revealed in each case: Signs of diarrhœa were present; the stomach was distended with a mass of undigested food material; ascitic fluid was present in the abdominal cavity, this varied in volume from about 3 oz. to 6 oz.; there was distension of the bladder with urine, which contained a large amount of cellular deposit; cirrhosis of the liver was present; indurated and necrotic areas in the spleen and intestinal walls were evident. Nephritis occurred in all cases, and a considerable quantity of sand was present in the stomach contents.

The feeding of sugar-beet tops ended on December 14th; kale and swedes then being substituted. For two days the appetites of the Angora rabbits were poor; about the third day, however, they appeared to be normal, with the exception of two individuals, one in each ration group; one of these rabbits, No. 42, did not recover its appetitie, but wasted away, and one month later had practically lost the use of the hind legs, making no apparent attempt to move about the pen. On January 12th, it was unable to raise the hindquarters, and died on the 14th in an emaciated condition. The spleen and liver were similar to those reported in Table III. With the exception of No. 42, there were no deaths after the cessation of sugar-beet top feeding, the appetites of the surviving animals gradually improved and appeared normal within a week of ceasing to feed the decaying sugar-beet tops from the field. The average body weights of the adult Angoras are set out in Table IV.

TABLE IV.

Average Body Weight of Adult Angoras during the Feeding of Sugar-Beet Tops.

Date weighed. 1931.	Control Ration lbs.	Control Ration ozs.	Hay and Green (or Root) Ration. lbs.	Hay and Green (or Root) Ration. ozs.
October 30	4	12	4	11
November 6	4	14	4	14
„ 13	4	13	4	11
„ 20	4	12	5	0
„ 27	4	14	5	0
December 4	4	8	4	14
„ 11	4	13*	5	3*
„ 18	5	0	5	7

* Deaths had started.

Examination of the individual weight records shows the increase in body weight on December 11th and 18th was due to increase in body weight of the survivors ; it was not a case of the small animals dying and the large surviving.

Discussion.

Equal numbers of albino and pigmented coated rabbits of similar adult weight were fed for six weeks on rations wherein sugar-beet tops were used as a greenfood ; by the end of the sixth week seven of the thirty (23 per cent.) albino Angoras were dead, and another wasted away, and died about one month later. No deaths occurred in the stock of thirty pigmented Havanas, although slight scouring occurred during the fifth to sixth weeks. The Angoras were divided into two groups : one (the control) receiving dry mash, oats, sugar-beet tops, and hay ; whilst the other (the hay and green) received sugar-beet tops, kale and hay. Although the control group received approximately 7 oz. of tops per head per day, against 12 oz. to the hay and green group, there were five (33 per cent.) casualties in the former against three (20 per cent.), followed by one other subsequently, in the latter. If this condition was due to the feeding of beet tops, it suggests that the total amount of sugar-beet tops given to an animal may be of less importance than the combination of foodstuffs provided in the ration. If the quantity of tops was a vital factor, one would have expected similar trouble in the Havana stock. Therefore one may ask : is the albino more sensitive to (*a*) chemical changes due to decomposition of green food in the ration ; or (*b*) to the presence of sand in the digestive tract ; (*c*) to a combination of (*a*) and (*b*) ; or is there some other explanation ? The Angoras (albinos) were doing productive work, yielding a clippable coat crop of approximately 10 per cent. of their live weight per annum, whilst the Havanas (pigmented) were not doing productive work at that time, but were resting until required for breeding in the following spring.

No serious digestive disorders were observed until the fifth week of feeding tops, at which time the leaves had reached an advanced stage of decomposition, necessitating removal of the rotted parts before feeding the crowns and centre leaves. The quantity of sugar-beet tops fed per rabbit per day had risen from an average of 6.2 oz. in the first week to 8.6 oz. in the sixth week to the control ration group, and from 11.5 oz. to 13.7 oz. to the hay and green ration group. Body condition improved in the rabbits, and the average weights increased fairly steadily from the first to the fourth week of feeding tops ; in the fifth week the weights declined, followed by deaths in the fifth and sixth weeks. The survivors, however, continued their weight increases after a fall in the fifth week ; the control group rising from an initial 75.6 oz. to 80.1 oz., and the hay and green group from 75.1 oz. to 87 oz. The victims manifested symptoms of extreme abdominal pain, death usually following within about twenty-four hours. The disturbances were first detected through loss of appetite, listlessness of the animal, which sat in a huddled posture in some corner ; this was followed by slight diarrhœa, and then in cases which exhibited distention of the abdomen,

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futile attempts to stand resulting in the belly resting on the pen floor, and in the loss of use of the limbs. The post-mortem findings are reported earlier. With the cessation of sugar-beet top feeding, and replacement with kale and swedes, there were no further cases, and the affected animals, with one exception, returned to normal within a week.

In consideration of the fact that beet tops are widely used for feeding farm animals, particularly cattle and sheep, it would appear important for stock owners to take care that the tops are: (1) not decomposed when used; (2) are not fed after heavy rains when leaves are soiled with sand and grit. One of us has recently investigated a condition in cattle showing symptoms similar to those reported in rabbits, where five animals died, and the post-mortem lesions were almost exactly similar to those of the rabbits. Sugar-beet tops had been fed to the cattle prior to the onset of symptoms. When the sugar-beet tops were replaced by other foods there were no further cases.

Summary.—(1) A case is reported of deaths occurring in a stock of White Angora (albino) rabbits used for wool production, but no deaths occurred in a stock of Havana (pigmented) rabbits which were not doing productive work. (2) The data indicates that the total amount of sugar-beet tops in the ration is of less importance than the combination of food materials. (3) Deaths did not occur until the fifth week of feeding wilted tops, by which time the leaves had reached an advanced stage of decomposition. Soil more readily adhered to the tops during the latter part of the feeding period. (4) It would appear that beet tops may be a cause of fatal illness in farm stock if used when decomposed or soiled with sand or grit.

The authors are indebted to Dr. Chas Crowther and to Professor R. T. Parkhurst for their helpful criticisms.

PARALYSIS AFTER MILK FEVER.

By J. M. BUCHANAN, M.R.C.V.S.,

Stowmarket.

In the March issue of THE VETERINARY JOURNAL, Mr. J. W. H. Masheter, M.R.C.V.S., relates some experiences of "Cerebral Meningitis in Cattle." His experiences, to my mind, were of great interest, and encourage me to mention one of my troubles. This concerns the inability of cows to get up after milk fever, which seems to be due to cerebral disability. As everyone knows, milk fever is no longer the bugbear to us that it was to the last generation. Recently, however, I found about 4 per cent. of my cases ending at the knacker yard. On discussing this at a veterinary meeting, I found that some of my colleagues had similar experiences. The symptoms probably are well known to your readers, but I here briefly recapitulate them. The cow is down, and apparently a typical milk fever case, but after treatment she fails to get up. She feeds and drinks,

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but is unable to rise, a typical " wooden feeling of the hind legs " being in evidence. Eventually the owner tires, and a bullet ends her career, usually at the end of three weeks—the usual limit. No medicine, either calcium or anything else, appears to have any effect. What is the differential diagnosis between this and milk fever as we know it ? And can any of my more fortunate colleagues prescribe a cure ? Post-mortem findings are *nil*.

Reviews

A Survey of Tuberculosis of Bovine Origin in Great Britain. Report of a Special Committee appointed by The People's League of Health, 12, Stratford Place, London, W.1. Obtainable direct. Price 1*s*. 6*d*.

THE People's League of Health is a body founded in 1917 by its hon. organiser, Miss Olga Nethersole. The committee making the present survey contains many eminent scientists, with a fair representation of the veterinary profession. The problems encountered during the survey are mainly medical, but some are purely veterinary. It is clear that from its inception the committee found the absence of comprehensive and accurate statistics to be a serious obstacle. The main body of the report consists of the tabulation and analysis of such evidence as is available, with conclusions based thereon. To the veterinary surgeon who follows the literature, there is nothing new, but the report is a valuable collection of figures, together with the deductions of a body well qualified to express its views. The material reported upon is largely the same (though in greater detail) as the recent report of the Minister of Health on " Bovine Tuberculosis in Man." Veterinary surgeons will question some of the estimates arrived at, particularly that which places the incidence of tuberculosis of the udder at only 0.2 per cent. of all cows. There is some evidence, and much opinion, that this figure should be at least doubled. Of the expressed views of the committee, that which depreciates the value and stresses the cost of routine examination of herds will not be endorsed. Critics may find much to say of the proposal to seek new legislation aiming at the compulsory pasteurisation of milk, but all will have to admit that the committee has considered all aspects of the subject in coming to the inevitable conclusion that there is no single practicable remedy for a scourge to which it has drawn new attention. This publication is worthy of study by all health authorities in Great Britain. The essential findings summarised are as follow: (*a*) Forty per cent. of cows are infected with tuberculosis ; (*b*) about 0.2 per cent. of all cows are suffering from tuberculosis of the udder ; (*c*) between 2 and 13 per cent. of raw market milk contains living tubercle bacilli ; (*d*) in England and Wales about 6 per cent. of all deaths (human) from tuberculosis are caused by the bovine type ; (*e*) about 2,000 deaths in England and Wales occur annually from this cause ; (*f*) at least 4,000 fresh cases of bovine infection in man develop yearly ; (*g*) the only classes of milk which can be considered safe are (1) that from herds certified under adequate control to be free from tuberculosis, and (2) milk which has been subjected to efficient pasteurisation or other approved process of heat treatment ; (*h*) that steps be taken to give permissive powers to the larger urban areas to require the efficient pasteurisation (or other accepted form of heat treatment) of all milk sold within their area which is not drawn from tuberculosis-free cows. H. T. M.

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Lehrbuch der Schlachtvieh-und-Fleischbeschau, for Meat Inspectors, Veterinary Surgeons, etc. By Ministerialdirector Prof. Dr. h. c. ROBERT v. OSTERTAG. Parts I, II, III. Stuttgart: Ferdinand Enke. 1932. With numerous illustrations in the text. Price each, M. 15. Three more parts to come. Price of whole work, bound, M. 94.

This is, in a measure, a new edition of Ostertag's "Handbuch der Fleischbeschau," but with a fresh title, so is not announced as a ninth edition, but is practically a new work. Part I deals with the history and laws of meat inspection, stamping of meat, and veterinary control, examination of fish and crustaceans, and methods of slaughter. As regards England, the author quotes McAllen as stating that "the universal carrying out of the law in the whole country is still a problem which presents the greatest difficulty." He points out that there are 115 private slaughter-houses in London, and 138 in Scotland. On page 129 there is an illustration of a handy case of instruments for use of veterinary surgeons in the inspection of meat. On page 207 there is an illustration of an electric skinning apparatus, which seems handy and practical. The electrical method of slaughter is discussed in the last few pages of Part I, and is favourably commented on and strongly recommended for the Jews.

Part II deals with the various ways of cutting up animal carcases, and then goes on to consider the lymph glands, and physiology and pathology, meat inspection questions, and diseases of liver, lungs, heart, udder, etc.

Part III carries on with further diseases of special organs, and includes poisonings, parasitic infections, and blood poisonings. As is usual in German works on meat inspection, long and painstaking consideration is given to the matter of trichinosis.

It is impossible here to go into an intimate review of all the admirable features of these new surveys of meat inspection. The hand of the master is evident on every page of the issues, the detail given is profuse and succinct, and the ground covered is almost amazing. The work could only have been done by a man who from year to year has gone on from strength to strength in his own special domain. The illustrations are good and plentiful, and add much to the value and interest of the parts. The printers have done their work well, and the lists of literature consulted will please even the elect.

Certified Milk. Proceedings of American Association of Medical Milk Commissions, Certified Milk Producers Association of America, and Metropolitan Certified Milk Producers.

THE subject matter of this volume falls under two headings: firstly, reports of local commissions, which are naturally more of American than general interest; the remainder of the book is composed of some twenty original papers and discussions on dairying and clean milk problems, and it is this section which should prove of interest to veterinarians generally. In the space allotted to this review it is only possible to briefly refer to several of these papers. "Should pasteurised milk be permitted to be sold raw, or raw and pasteurised, or only pasteurised?" by W. H. Park, M.D., is reported on p. 155, *et seq.* It is somewhat difficult for us in England, where we have so many really urgent problems in connection with milk, to adequately appreciate the significance of such a subject. The author states that while American certified milk is nearly perfect, there is still a possibility of contamination and slight danger, and he proceeds to detail the sources of this contamination, most of which he states is of human origin. Undulant fever, which is receiving rather a lot of attention at the moment in America, is mentioned in this paper. The methods of pasteurisation are outlined, and it is noted that it is now possible to carry out this process in the final container. The paper reported on p. 287 should be read in conjunction with the above: it is a strong argument in favour of the continuance of sale of raw certified milk.

"The Control of Bang's Disease of Contagious Abortion from the Standpoint of the Producer of Certified Milk," by Dr. C. P. FITCH, p. 246, *et seq.*, is an interesting

paper, in the introduction of which references are made to the relationship of mineral deficiencies to breeding. There is a somewhat surprising statement to the effect that hygromas (or " big-knees ") in cattle, are in many cases associated with Bang's bacillus (p. 249). The author points out that Bang's disease, a name he prefers to contagious abortion, does not lend itself to biological or medicinal control, and he stresses the undesirability of using live vaccines.

" The Diagnosis and Control of Mastitis," by D. H. UDALL and S. D. JOHNSON, p. 231, *et seq.*, gives details of the authors' methods of examination of the herd, which involves : (1) the physical examination of the milk with the aid of a strip cup ; (2) testing of milk for alkalinity, using bromothymol and phenol red as indicators ; (3) the bacteriological examination of the milk ; (4) the physical examination of udders. The importance of taking into account all findings is stressed, and a table of results is quoted as an example. Other subjects considered include mineral and vitamin requirements of dairy cows, milk bacteriology problems, and several papers on septic sore throat. The concluding chapter contains particulars of methods and standards for the production and distribution of certified milk, and these in essentials are the same as those adopted in this country ; but they differ in several important details, notably the greater frequency of veterinary examinations and the more stringent regulations in regard to the medical examination of employees. The bacterial count enforced is under 10,000 per c.c. Steps are also to be taken to eliminate Bang's abortion disease from certified herds.

Nutrition : Abstracts and Reviews. Published from the Imperial Bureau of Animal Nutrition under the editorship of John Boyd Orr, J. J. R. Macleod, and Harriette Chick. Aberdeen University Press, Ltd. Annual subscription, 21*s.* net.

The recent extension of research in animal nutrition and of the application of its results to human and veterinary medicine and to animal husbandry, has been so great, and the reports of work appear in so wide a range of journals, that it has become impossible for anyone to see the whole literature. The research worker is compelled to limit his reading to the aspect of the subject in which he is more particularly interested, although obviously advances in knowledge in other fields may have a bearing on the problem on which he is working. On the other hand, those engaged in the application of the science of nutrition in human and veterinary medicine, or in stock farming, find it difficult to keep themselves informed regarding advances in fundamental research upon which improved practice is based. The purpose of the journal under review, the first number of which is before us, is to satisfy this obvious want by collecting under one cover abstracts of all literature bearing on nutrition. The journal begins with literature published in January, 1931, and some idea of the immense scope of the understaking may be appreciated by the statement that some 450 periodicals in all are now being reviewed.

In the selection of papers for abstracting, one great difficulty is to determine the boundaries of the science of nutrition, but, as stated in an introductory editorial, it has been thought advisable to take a wide view, and to err on the side of inclusion. In the case of diseases, for example, it is now known that faulty nutrition is the direct cause of the so-called deficiency diseases, and that it may also affect the susceptibility of animals to certain infectious diseases. Further, dietary measures form an important part of therapeutics. Finally, recent experience has shown that nutrition plays a rôle in the ætiology of many diseases where such a factor was only vaguely suspected, such as, for example, pernicious anæmia, the neuroses and nephritis. Abstracts of publications dealing with all such problems will therefore find a place in the new journal.

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For the convenience of the reader, the abstracts have been arranged in six main sections: technique, composition of foodstuffs, physiology of nutrition, dietetics, feeding of animals, diet in relation to health and disease. In addition, a certain amount of space will be devoted in each issue to reviews of various kinds. The task of the reader is facilitated by the provision of an index of authors. It is hoped that the journal will be of use not only to research workers, but to all interested in nutrition, and that they will co-operate with the editors in making the publication of the greatest service. The printer's share of the work has been carried out excellently.

The Science of Meat and the Biology of Food Animals. By E. P. LANE, B.Sc. Lond. Vol. I. Pp. 560, with 184 illustrations. Published by *The Meat Traders' Journal*. Price 10*s*., postage 9*d*.

THIS work covers a surprisingly wide field, and the author is to be congratulated on the manner in which he has handled the material, compiling a volume of interest to all connected in any way with the meat industry, and which should fulfil its intended purpose, namely, to be a text-book for students working for the diploma of the Meat Traders' Federation. Parts I and II, which deal with the simple fundamentals so essential to this type of reader, outline the general principles of hygiene and the essentials of anatomy and physiology. Part III, however, consisting of some two hundred pages, is not only of interest to the lay reader, but should prove valuable in introducing the subject to the veterinary student. The facts are explained in simple language, supported throughout by a large number of explanatory illustrations. The low cost of the book should prove an added attraction. It is understood that Vol. II, not yet to hand, will deal with the more advanced aspects of the subject.

The Lymphatic Glands, Jointing of Carcases, Animal Anatomy, Drawings for Students of Meat Inspection. By JAMES GOODFELLOW, M.S.I.A. London: The Sanitary Publishing Company. Price 3*s*. 6*d*.

THE student will find this little book very useful, as the drawings are excellent reproductions of the split carcases as found in the slaughter-house when prepared for inspection. The positions of the lymphatic glands are clearly indicated in the drawings. The manner in which the carcase is cut into joints, and the names given to them as commonly known to the butcher, makes it a useful little handbook for the beginner; but it is quite obviously not intended for the qualified man.

Practical Physiological Chemistry. By HAWK and BERGEIM. London: J. & A. Churchill. Pp. xviii + 929, 279 illustrations. Price 32*s*. net.

SINCE the publication of the first edition twenty-five years ago, this work has increased to five times its original size. After the usual opening chapter on the physico-chemical properties of solutions, much space is devoted to the classification, chemical properties and significance of proteins, fats and carbohydrates. The body enzymes and digestive analyses are treated very fully, and an interesting chapter on putrefaction and detoxication is supplied. A well-illustrated section on blood and respiratory metabolism introduces the use of the colorimeter, nephelometer and spectroscope to the student. A few pages on the endocrines precedes the general work on energy metabolism. Chapter XXIX deals with the vitamins very excellently, and details of methods for their biological assay are provided. Clinical photographs, diagrams and charts concerning the deficiency diseases serve to make this chapter

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very fascinating reading. The last 200 pages are devoted to normal and pathological urine. Contrary to most practical books of this nature, there is shown a free departure into physiological and even pathological discussion which indicates the significance of the experiments which follow, and tends to stimulate greater interest. Its place in the physiological laboratory being assured, it is also to be recommended to the student of advanced physiology.

A Guide to Human Parasitology. By D. B. BLACKLOCK, M.D., D.P.H., and T. SOUTHWELL, D.Sc., Ph.D., F.R.S. Ed. London: H. K. Lewis & Co., Ltd. Pp. viii + 272, 122 figures, 2 plates. 15*s*. net.

THE book is written with the intention of satisfying the requirements of the medical practitioner and those taking post-graduate medical courses, and its interest to veterinarians is consequently only of a subsidiary nature. The title is somewhat misleading in that the volume only deals with protozoology and helminthology, the insect and arachnid parasites not being considered. The introductory pages, thirty in all, are written in a practical manner, and indicate the methods by which the beginner may gain practice and become efficient in general parasitological technique, and the authors in this connection wisely stress one very important point, namely, the importance of the recognition of the normal in the examination of material. The section dealing with protozoology is essentially of medical interest, although leptospiral jaundice in dogs is referred to on page 39.

The helminthology section is divided into discussions on Cestoda, Trematoda, and Nematoda. Only the essential points of recognition of each parasite are stressed, and the student is thus not overburdened with unnecessary details. While the classification adopted has its advantages, it does, as the authors point out in the preface, break down when applied to parasites other than those of man. It is somewhat difficult to appreciate the constant references (page 2, and in the section dealing with Cestoda) to the demonstration of tænia eggs in human and canine fæces. This is certainly not the experience of veterinarians. On page 123 it is stated that echinococcus cysts may attain the size of a child's head, and the student is left to draw his own conclusions as to their average size, and also their more particular characters. Summarising tables are given at the end of each section, and the life histories are illustrated by means of a series of diagrams. The reader is left with a feeling that the manual would be greatly improved by the inclusion of further details regarding the practical application of the subject, particularly in reference to symptomatology and preventive measures.

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